Appendix K2

US 281 Schematic - Preliminary Project Cost Estimate

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Prepared For:

US 281 EIS
PREFERRED ALTERNATIVE SCHEMATIC – ENGINEERING SUMMARY REPORT

August 2014

Note: This Document is released under the authority of Douglas Huneycutt, PE 62830, on August 12, 2014 for Alamo RMA review. It is not intended for construction or permitting purposes.

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1 INTRODUCTION

1.1 Purpose

The purpose of the US 281 Corridor Project is to improve mobility and accessibility, enhance safety, and improve community quality of life. The Preferred Alternative Schematic addresses these previously defined purposes in response to the Preliminary Final Environmental Impact Statement study. The Preferred Alternative as defined in the Draft Environmental Impact Statement (DEIS) is a refinement of the Expressway Alternative, dated April 2013. The Preferred Alternative Schematic has been developed to a geometric level of accuracy required to understand, evaluate, and determine the potential impacts and then engineered to provide technical solutions representative of the Preliminary Final Environmental Impact Statement.

1.2 Limits and Project Description

1.2.1 Project Description

The US 281 Preferred Alternative will become a Controlled Access highway consisting of Main Lanes, and Frontage Roads connected by Exit and Entrance Ramps to provide access to and from the local street network and adjoining properties.

The main lanes and the ramps will be designed for higher speeds to provide unimpeded flow from LP 1604 to Borgfeld Dr. Safety features include concrete median barriers separating opposing mainlane traffic, gentle main lane grades, 12-foot wide mainlanes, wide shoulders on both sides of the mainlanes for vehicle break downs, mild slopes adjacent to the mainlane shoulders, green overhead guide signs with local street information, higher speed exit ramps with a transitional area to the lower speed frontage roads, higher speed entrance ramps from the frontage roads with auxiliary lanes as needed to merge with mainlane traffic, and one-lane ramps with some two-lane ramps where needed based on traffic volumes and operational needs.

The mainlanes will cross over major intersecting streets via an overpass. Intersecting local streets at these overpass locations will be controlled with traffic actuated signals. No driveways or local streets will have immediate access to the mainlanes. Access from local streets and driveways is provided via the frontage road system and then ramps to the mainlanes.

Direct Connector ramps from Loop 1604 westbound and eastbound to US 281 northbound and from US 281 southbound to Loop 1604 westbound and eastbound will complete the fully directional interchange. The one-lane ramps from Loop 1604 merge together as two-lane ramps and enter US 281 as two-lanes. Conversely, the two-lane exit ramp from southbound US 281 will split into one-way ramps for the eastbound and westbound directions.

The managed lane, one in each direction, will begin just north of LP 1604 and continue to Stone Oak Parkway. At Stone Oak Parkway, all three mainlanes will become managed lanes and continue past Borgfeld Dr. The transit lanes are accessible from the managed lane. The transit lanes rise above the managed and freeway mainlanes to form a T-intersection and a connection into the proposed VIA Park-n-Ride garage. The transit lanes approaching the T-intersection are designed for lower operating speeds.

Frontage roads, operating at a lower speed, will provide driveway access to private property. Proposed auxiliary lanes will transition exiting ramp vehicles from a higher speed on the mainlanes to a lower speed along the frontage road. U-turn lanes will be provided at the overpasses for traffic desiring access to the opposing frontage road. Additional lanes on the frontage roads at the street intersections will allow vehicles to use a separate dedicated lane for turning either left or right. Three-lane frontage roads are planned from Loop 1604 to Stone Oak and then two-lane frontage roads are planned from Stone Oak to Borgfeld.

Sidewalks, compliant with the American Disability Act (ADA), are located adjacent to curbs on the right side of the frontage roads and along the cross streets as they pass beneath the overpasses. ADA ramps will be included with cross walks and audible/visual pedestrian signals.

Bicycle traffic is accommodated along the frontage roads through a widened outside lane (15 ½ feet to face of curb as opposed to the normal 13 ½ foot width). Along the cross streets, the outside through lane is also widened on the right side to provide room for an automobile/truck to travel concurrently in the same lane with a bicycle.

Throughout the project, new drainage structures will be constructed. Filtration and/or Detention systems are planned to address water quality and compliance with the Texas Commission on Environmental Quality (TCEQ) requirements for construction within the contributing zone of the Edwards Aquifer. A San Antonio landscaping scheme using xeriscape principals will guide the application of vegetation for the bioretention facilities, designed to meet the TCEQ filtration guidelines.

Project wide aesthetics are adopted from the TxDOT Hill Country theme, the same theme used on the direct-connector ramps at the current US 281/LP 1604 interchange. This theme will be applied to bridge structures, retaining walls, and overhead sign supports.

1.2.2 US 281 Corridor Limits

The US 281 corridor, 7.95 miles long, begins at the Loop 1604 interchange and continues northward to Borgfeld Drive. From Borgfeld Drive, the US 281 project merges back into the existing configuration at the south end of the Cibilo Creek Bridges. The entire project is located within Bexar County.

1.2.3 LP 1604 Direct Connectors

Four proposed direct connector ramps will be added to the US 281 & Loop 1604 interchange on the north side of Loop 1604 to form a fully directional direct connected interchange. The existing four southern connectors were constructed under a previous construction contract with bifurcation bents to provide for the four northern connectors. The existing ROW adequately accommodates the new structures. Single lane connectors are provided heading east and west from Loop 1604 and proceeding north on US 281. As the two connectors approach US 281, they merge together into double lanes and transition via auxiliary lanes and an additional through lane northbound. Similarly, the southbound ramp departs from US 281 as a double exit ramp and bifurcates into single lanes as the ramps depart east and west to Loop 1604 mainlanes.

1.2.4 Managed Lane Concepts

The managed lanes concept is defined here by directional orientation, i.e., Northbound and Southbound.

<u>Northbound</u> managed lanes begin north of Sonterra Blvd. The inside lane, adjacent to the median barrier rail, of the three freeway lanes is designated as the managed lane. Northbound drivers are notified first, 4/10 mile south of the Loop 1604 interchange, of the upcoming “Toll Lane Entrance One-Mile Ahead” and then again just north of Loop 1604 of the upcoming “Toll Lane Entrance ½ Mile Ahead”. This is the only entrance for the tolled lanes until past Stone Oak Parkway/TCP Parkway. The toll lane traffic is not permitted to exit until past Stone Oak Parkway. The direct connector ramps from Loop 1604 cannot enter into the toll lane due to the tie-in of the direct connect ramp with the US 281 freeway lanes near Redland Road, well north of the toll lane entrance. The toll lanes are separated from the freeway lanes with an 8’ wide buffer and vertical flexible delineators. During emergencies, access to the freeway lanes and the tolled lanes can occur by driving over the flexible delineators. The twelve foot wide tolled lanes are separated from the concrete median barrier with a ten foot inside shoulder.

Past Stone Oak Parkway/TCP Parkway and the Marshall Road exit, all freeway lanes become tolled lanes with full access to exit and entrance ramps. The Marshall Road exit, signed as the “Last Free Exit”, is a two-lane exit ramp to the free access frontage roads. Three northbound toll lanes are provided to north of Trinity Park where the outside lane merges inward leaving two tolled lanes northbound. The two tolled lanes continue to north of Borgfeld where they end and transition into the non-tolled lanes.

<u>Southbound</u> managed lanes begin 3/10 mile south of the Cibilo Creek bridges. Traffic headed south from Comal County on non-tolled lanes is provided with a two-lane exit ramp to the free access frontage roads. Three tolled lanes with full access to exit and entrance ramps are provided from the exit ramp to south of Northwind Boulevard at the entrance ramp. The two outside toll lanes become freeway lanes. The inside

single lane continues southward to south of Redland Rd where it merges with the two freeway lanes. From the single toll lane, no access is allowed to the exit and entrance ramps, including the southbound US 281 direct connectors. Access to the US 281 direct connectors must be chosen where the two outside lanes become freeway lanes, south of Northwind Boulevard.

1.2.5 VIA Transit Center

VIA Metropolitan Transit (VIA) is planning to construct a bus/carpool Park-n-Ride transit facility at the southwest quadrant of the US 281/Stone Oak Parkway. The facility will be multi-storied and as such, VIA desires access to the facility from the managed lanes to the top of their facility. The Preferred Alternative provides this connection at the center of the US 281 between the tolled lanes. From the south, northbound access is gained by entering the tolled managed lanes as described above. North of Evans Road, an additional transit lane is formed separate from the tolled lane and elevates via retaining walls to a second level above the freeway lanes.

Southbound, the entrance to the transit lane is also from the tolled lanes, north of Stone Oak Parkway. The transit lane separates from the tolled lane and elevates on retaining walls above the freeway lanes.

South of Stone Oak Parkway, the southbound transit lane joins the northbound transit lane to form a signalized T-intersection with a bridge over to the VIA Park-n-Ride Facility. A common bent near the proposed right-of-way (ROW), to be constructed by VIA, sets the US 281 project limits and the beginning of the VIA facility.

VIA Metropolitan Transit held a meeting on June 19, 2014 with their VIA transit facility consultant (Vickery & Associates, Inc.), ARMA, TxDOT, and Jacobs to discuss the interface between their proposed facility and the US 281 EIS corridor project. Key points are as follows:

- Centerline of the crossover bridge is located at the US 281 centerline Station 473+29.43
- The bridge is 69 feet wide outside to outside
- The transition bent centerline from the US 281 construction to the VIA facility construction is approximately 251.82 feet left of Station 473+29.43
- The transition bent will be constructed in the VIA contract. The bridge from the US 281 centerline to the transition bent will be constructed by the US 281 contract.
- Aesthetics will be according to the TxDOT Hill Country Theme.
- VIA acknowledges that the bent should be constructed by March 2016.

- VIA's schedule is to be under a design-build contract by mid-2015 with completion in late-2016. 30% bridge plan documents to be provided August 2014.

1.3 Ramps

The US 281 corridor provides numerous locations where exit and entrance onto the freeway lanes or tolled lanes is provided. Locations were identified that provided the maximum amount of access with consideration of existing and proposed streets, existing driveways, safe connection with the Free-Access lanes with consideration of intersection movements and vehicle stacking distances. Auxiliary lanes (lanes that provide safe weaving) were included where necessary to meet minimum weaving distance requirements between ramp-to-ramp connections with the main lanes and the frontage roads. A System Capacity Analysis was performed to determine the number of lanes needed for each ramp. Although some ramps only required one-lane for capacity, two were sometimes provided to provide continuity of the non-tolled system. The desire to maximize the access to adjacent properties and to cross streets also forced the addition of braided ramps, or ramps in the same general vicinity where the exit and the entrance ramps are inter-woven and separated by a bridge and retaining walls.

2 SCHEMATIC DESCRIPTION

2.1 Preferred Alternative Schematic

The Preferred Alternative Schematic is a refinement of the Expressway Alterative as identified in the Draft Environmental Impact Statement (DEIS). Per the DEIS, *"The Expressway Alternative is a limited access facility with continuous one-way frontage roads along US 281. It consists of three main lanes and two/three frontage road lanes in each direction."* The refinement of this description continues as a limited access facility, but also defines the application of tolling and transit lanes.

2.2 Control-of-Access

Generally, access to local properties was retained in its current location or adjusted to another location within the limits of the respective parcel.

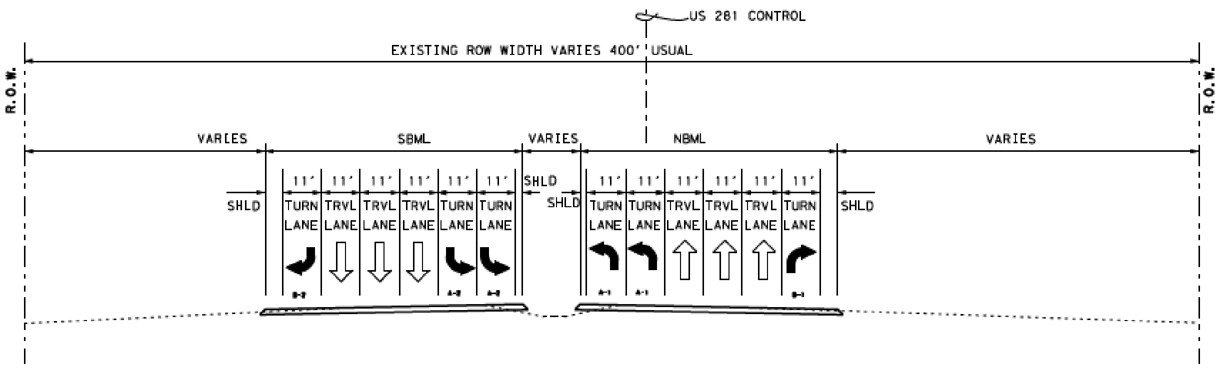
2.3 Right-of-Way

The US 281 project from Loop 1604 to the San Antonio City Limits was constrained to fit within the existing ROW previously acquired under another project. The ROW width is generally between 400 feet and 450 feet wide. North of the San Antonio City Limits to the Cibolo Creek, additional ROW has been designated for acquisition. The general ROW width has been set at 400' wide. Right-of-Way needs for this US 281 corridor have generally been determined from the roadway typical sections and the appraisal district parcel maps. Further refinement of this information is underway to survey and map the existing properties and then subsequently the proposed improvements to determine the precise ROW needs.

3 TYPICAL SECTIONS

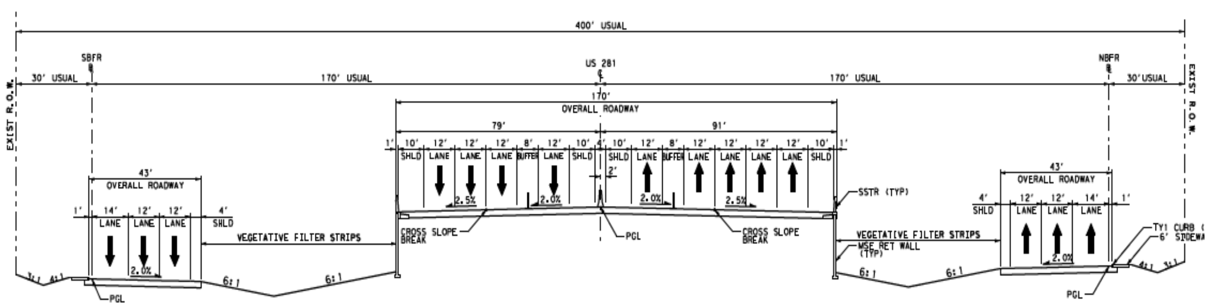
3.1 US 281 Section

The US 281 typical section varies through the corridor and depends upon the need for auxiliary lanes, exit and ramp locations, and property access. Existing non-tolled capacity remains the same, perhaps in a different physical location. The existing lanes generally consist of three through lanes from Loop 1604 to past Stone Oak Parkway.



EXISTING US 281 Typical Section
Loop1604 to past Stone Oak Parkway

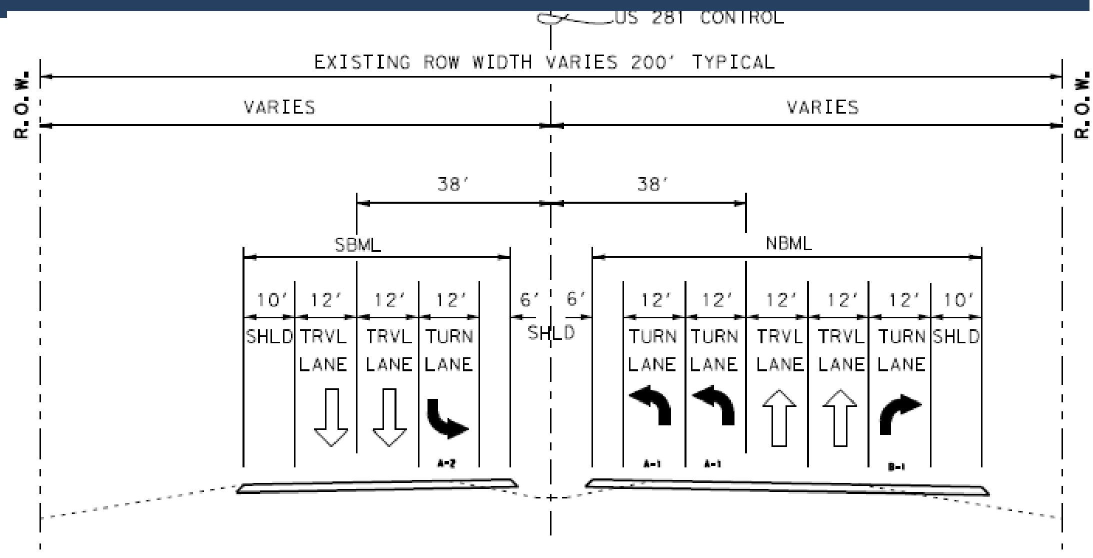
The proposed section provides for the same number of non-tolled lanes plus some additional capacity resulting from the addition of frontage roads, auxiliary lanes, and the tolled-lane. Also, on the frontage road, bicycle accommodation is provided by widening the outside lane to



PROPOSED US 281 Typical Section
Loop 1604 to past Stone Oak Parkway

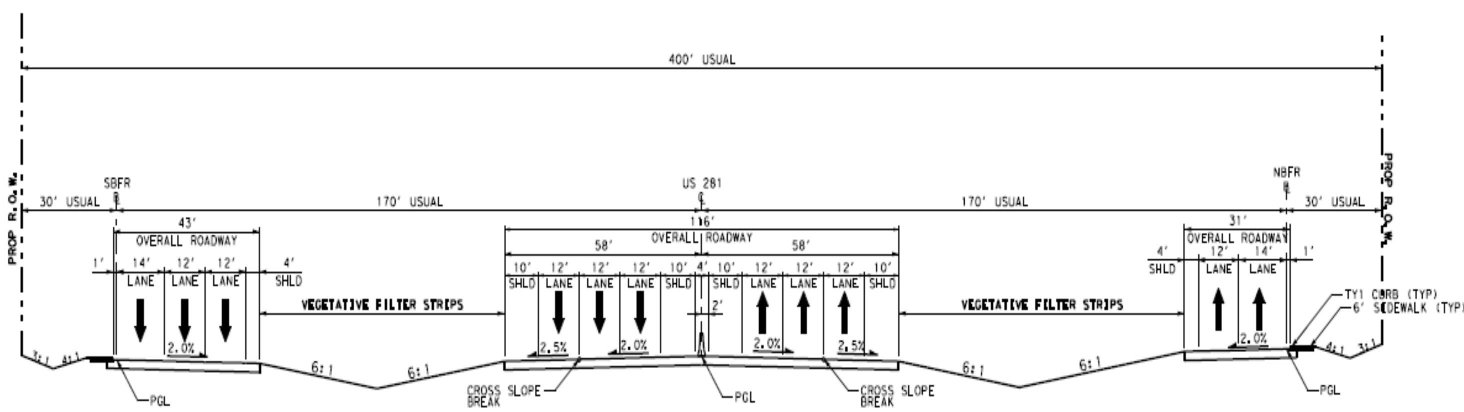
15 foot wide. 5’ wide sidewalks on each frontage road are also provided.

North of Stone Oak Parkway, the existing configuration is two –lanes in each direction. Additional lanes that may exist are short in length and considered to be auxiliary lanes as opposed to thru lanes.



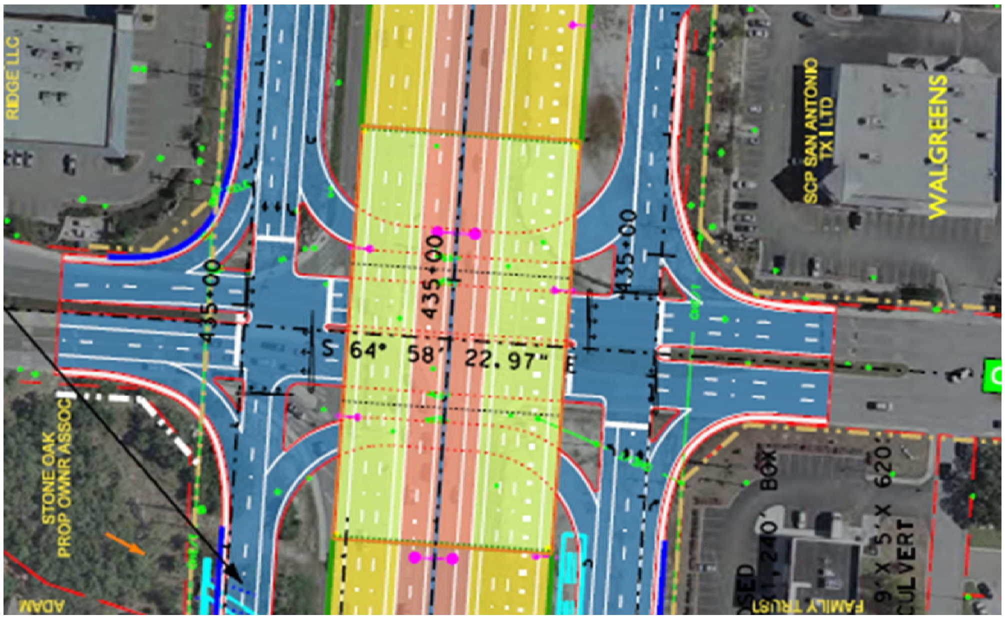
EXISTING US 281 Typical Section
North of Stone Oak Parkway

The proposed configuration north of Stone Oak generally consist of three tolled lanes in the center and a minimum of two free access frontage road lanes in each direction.



PROPOSED US 281 Typical Section
North of Stone Oak Parkway
Ultimate 3-LaneSection

Local streets were generally improved from their current lane configuration into a roadway section with two thru lanes and a left turn-lane in each direction. U-turn lanes at each intersection are also provided.



Stone Oak Parkway at US 281
Example Intersection configuration

4 GEOTECHNICAL

Subsurface investigation has not been performed to determine the bearing capacities for the bridge and sign foundations. A *Geotechnical Engineering Study* by ARIAS & Associates was furnished by TxDOT for the basis of the pavement design only. The November 2, 2007 geotech study covers the section of US 281 between Loop 1604 and Marshall Road. A complete geotechnical study is recommended for the detailed design phase of this corridor.

5 ROADWAY

5.1 Functional Classification

This section of highway has been classified by the Bexar County MPO and TxDOT as an **Urban Principal Arterial.**

5.2 Design Speed

The proposed design speed for the US 281 mainlanes is **65 MPH.** The frontage road design speed is set at **45 MPH.**

5.3 Design Criteria

The *TxDOT Roadway Design Manual* was the primary resource for design criteria and guidance. This resource was supplemented with AASHTO's *Policy on Geometric Design of Highways and Streets* when necessary. The *Managed Lanes Handbook*, developed by Texas Transportation Institute for the Texas Department of Transportation, was referenced to determine the design criteria for the managed lanes. The geometric design criteria selected for this project is provided in Appendix A.

5.4 Retaining Walls

Extensive retaining walls were required throughout this project due to the constrained Right-of-Way width and the rolling terrain. A combination of retaining walls were considered including Mechanically Stabilized Earth walls for fill locations, Soil Nail Walls in cut locations, Cast in place Type C curb walls, and exposed rock walls. Due to the uncertainty of the geotechnical conditions, all exposed rock walls were estimated as Mechanically Stabilized Walls or Soil Nail Walls.

5.5 Noise Walls

Noise walls could be required for this project. Currently, a couple of areas have been considered for the implementation of the walls. Due to the EIS process and the Record of Decision not expected until November 2014, coordination with the adjoining land owner groups will not occur until the end of the EIS process is complete and the Record of Decision has been rendered. Therefore, no noise walls are depicted on the Preferred Alternative Schematic or estimated in the construction estimate. Any noise walls determined to be required are expected to be a cantilever wall either on spread footings or drill shaft foundations.

5.6 Curbs

Curbs will be used continuously on the outside of the frontage roads and on the inside shoulders at intersections beginning on the frontage road where the lanes begin to widen for the turn lanes and continuing through the intersections on the islands and U-turn lanes. The design speed on the frontage roads is 45 MPH, therefore, a Type 1 Curb (San Antonio District STD) is specified.

5.7 Pavement

Pavement Design was based upon the ARIAS & Associates *Geotechnical Engineering Study*, performed under a previous contract. It should be noted that the project study limits were from Loop 1604 to Marshall Drive and did not include the northern limits of the current US 281 EIS project.

1) All Portland Concrete Pavement – 12" CRCP on the Main Lanes and Ramps & 9" CRCP on the Frontage Roads and Cross Streets;

2) A combination of Portland Concrete Pavement and Asphaltic Concrete Pavement – 12" CRCP on the Main Lanes and the Ramps & 17 ½" ACP on the Frontage Roads and Cross Streets; and

3) All Asphaltic Concrete Pavement – 22 ½" on the Main Lanes and Ramps & 17 ½" on the Frontage Roads.

While any combination of these pavement strategies may meet the project needs, further pavement design should be performed to identify the most feasible for the construction and appropriate for the US 281 pavement life-cycle.

6 STRUCTURES

6.1 Determination of Required Structures and Basis of Preliminary Design Criteria for Structures

This section describes the basis for the preliminary design concerning structures within the US 281 EIS project. Four director connectors finish the interchange between US 281 North and Loop 1604; nine overpasses span over intersections of existing roads; three braided ramps cross with proposed entrance and exit ramps; and two bridges tie the proposed managed lanes with the VIA Park-n-Ride Facilities. For the preliminary design, criteria were gathered from the following specifications and manuals: TxDOT LRFD Design Manual, TxDOT Standards Specifications, TxDOT Detailing Manual, San Antonio District Urban Design Themes, and AASHTO LRFD Specifications. A brief discussion of the superstructure design, substructure design, direct connectors, overpasses, braided ramps, VIA connectors, and retaining walls and miscellaneous structures is provided in the following sections.

6.2 Design Basis for Superstructure Design

Prestressed concrete Tx54 girders and steel plate girders were used in the preliminary design of the superstructure. The steel plate girders were utilized for long, curved spans on the direct connectors where prestressed concrete girders were not appropriate due to geometric or structural capacity. These spans ranged from 142.5 ft. to 205.5 ft. and consist of three simply supported spans and one four-span continuous unit. All other spans on the project consist of prestressed concrete Tx54 girders to optimize span lengths, economics, and minimize approach earthwork. Span lengths for the bridges were made as consistent as possible to reduce the amount of girder designs and reduce the fabrication cost. Girder spacing was dependent on the span length. Design requirements provided in the bridge design manual were satisfied except one span on the EBNB Direct Connector which requires a non-standard slab design to accommodate a large non-standard slab overhang. All other spans will utilize a TxDOT standard slab.

6.3 Design Basis for Substructure Design

The preliminary design for the bent caps is based on utilization of the conventional bents defined by TxDOT's Hill Country Theme for multi-column and single column bents. Straddle bents were specified where braided ramps and the direct connectors crossed underlying roadways. In cases where the site conditions required either a long steel plate girder span or two shorter concrete spans with use of a straddle bent, it was determined that utilizing the shorter concrete spans with straddle bents were more economical. Concrete inverted tee caps or steel box caps for the straddle bents were chosen based on impacts to the construction schedule, safety, or impacts to traffic. A tapered rectangular cap design was used on the typical hammerhead bents and cantilever bents. The columns on multi-column bents were limited to a maximum spacing of 18'. Geometry on all columns is based upon the San Antonio District Urban Design Themes Hill Country Region. Where possible, columns were placed outside of the horizontal clear zone. However, when columns were required within the clear zone, appropriate traffic barrier protection was specified. All abutments followed the TxDOT standard abutment geometry. Post-tensioned caps and columns were not specifically identified in the schematic. However, some post-tensioned bent caps are anticipated for this project. The quantity for post-tensioning was not accounted for on the direct connects. The unit cost of bent concrete was increased to account for this item.

For the foundations, standard 36" diameter drilled shafts spaced at an 11' maximum are specified for the abutments. Multi-column bents required 36" to 48" diameter drilled shaft under each column depending on the column size, 72" diameter drilled shafts on straddle bents for each column, and a single 96" diameter drilled shaft for the single column bents on straight sections. Four drilled shafts and a footing were placed on the direct connector bents on a horizontal curve. Different footing and drilled shaft sizes were applied for steel spans, concrete spans, and cantilever bents based on comparable design completed for other projects.

6.4 Direct Connectors

Four direct connectors are specified to provide a fully directional interchange at US 281North and Loop 1604. The northern connectors provide connectivity to the north part of US 281 with east and west bound Loop 1604. The four ramps tie into gore areas of the existing direct connectors and a proposed entrance and exit ramp of US 281. Concrete spans are used throughout where possible, requiring only 7 steel spans in the project. The steel spans are required for spans over 140 ft due to areas with restricted bent placements caused by underlying roadways and bridges. Eight steel straddle caps were used along with two concrete straddle caps and nine cantilever bents. All other bent caps were standard hammerhead bents matching the aesthetics used on the existing direct connectors.

6.5 Overpass Structures

Nine overpasses span over various existing roadways. The bridge limits and span configuration were dictated by site conditions, underlying roadways and U-turns. The bridge limits are also a function of the retaining wall heights. Currently the Wilderness Oak/Overlook Parkway Overpass is a 17-span bridge. The number of bridge spans between the two cross streets may be reduced and replaced with retaining walls depending on the site conditions. A more detailed assessment of the site conditions can be performed during the design phase by a geotechnical engineer to make an appropriate determination for use of bridge versus retaining wall based on slope stability, soil bearing capacity, and sliding characteristics. This may help reduce the overall length of bridges on the project. Prestressed concrete Tx54 girders are used for all the overpass bridges.

6.6 Braided Ramps

Three braided ramp bridges were required on the project when entrance and exit ramps were required to cross at a specified location. Prestressed concrete Tx54 girders with single column and concrete straddle bents were used. The three bridges are either four or five spans spanning another ramp. Bridge limits were set based on the location of the underlying ramp. The ramps are designed for the required design speeds which can be seen in the Roadway Section. The straddle bents were required due to the length of spans and tie in locations of the ramps. The beginning and end of bridge were set where retaining walls would clear the underlying ramp with the required horizontal clearance of the underlying ramp.

6.7 VIA Connectors

Two VIA bridges are proposed near the Stone Oak Intersection. The location of the VIA Connectors is a function of the VIA facility and parking garage. The US 281 transit bridge along the US 281 centerline is a long bridge due to a long vertical curve to meet required vertical clearances for the VIA transit bridge over Southbound US 281. This bridge is smaller and connects traffic from the US 281 transit bridge and the VIA Park-n-Ride facilities. The bridge will tie into the top floor of the VIA parking garage allowing the correct approach and departed grades which is the basis for the profiles of the VIA Connectors. Due to the required turn radius between the two slabs, two caps from the US 281 transit bridge extend to support the large slab overhangs. These two bents may require post-tensioning due to excessive overhangs. The slab is a thickened non-standard slab to assist in carrying the loads which will not allow precast concrete panels in this area of the slab. All other bents are multi-column bents and all spans utilize Prestressed Tx-54 girders. The rails may also have to be incorporated as beams to support some the of the overhang loads.

6.8 Retaining Walls and Miscellaneous Structures

There will be two main types of walls used on the project: fill and cut walls. The fill walls will be MSE walls where embankment is added for the approaches of the bridges or other areas where the elevations and distance between adjacent roads or Right-of-Way will not warrant sloping of the embankment. Cut walls will be either soil nail or rock nailed walls. This will be dependent on the existing soil material. These will be in areas where proposed roadways will be below the existing ground elevations. Sound walls will also be required at locations to be determined once input is gathered from public meetings. Final design, geometry, and aesthetics of the sound walls can then be decided.

Some of the sign structures will be attached to bents on the bridges. The connections will follow TxDOT standards. For more of the sign structure information, see the Traffic Signing Section.

7 TRAFFIC

7.1 Illumination

7.1.1 Lighting Requirements

The TxDOT *Highway Illumination Manual,* the AASHTO *Roadway Lighting Design Guide,* and *the* IESNA RP-8 *American National Standard Practice for Roadway Lighting* govern this roadway lighting design. One of the goals of roadway lighting design is to provide the minimum number of light poles that maintain the proper illumination light levels. One way to achieve this is to place poles with two mast arms in the center median area to illuminate both directions. A second method is to increase the height of the poles. The heights of conventional poles are between 30 ft. and 50 ft.; the heights of high masts poles are between 100 ft. and 175 ft.

In November 2008 the City of San Antonio adopted an ordinance, Ordinance 2008-12-11-1133, creating a Military Lighting Overlay District to regulate outdoor lighting near certain military installations within the city limits. The overlay district surrounds an area within 5 miles of the perimeter of Camp Bullis, Camp Stanley, Randolph Air Force Base or Lackland Air Force Base. According to GIS information, the closest military installation to the project area is Camp Bullis, which is approximately 4 miles from the closest intersection, US 281 and Huebner Rd. Therefore, conventional poles were used for the roadway lighting design.

7.1.2 Existing Lighting

There is existing lighting on US 281 between Loop 1604 and north of Sonterra Road (Sta. 325+00 to Sta. 346+00), which is on the southern end of the project limits. This lighting is dual arm poles at approximately 300 ft. spacing on top of the concrete median barrier. There is no roadway lighting for the remainder of the project.

7.1.3 Lighting Design

Conventional lighting will be installed for US 281. The conventional lighting starts at Sta. 346+00 and ends at Sta. 745+00. The lighting for US 281 includes understructure, continuous, and safety lighting assemblies.

The continuous lighting will be placed with poles mounted on the new concrete median barrier, bridge rails, and retaining walls. These poles will use 48 ft. poles with 400 W TxDOT approved fixtures on the new concrete median barrier mounts or bridge lighting mounts. Understructure lighting need to be installed on the bridges that go over the Redland, Encino Rio, Evans, Stone Oak Pkwy., Marshall Rd., Wilderness Oaks, Overlook Pkwy., Bulverde Rd. and Borgfeld Dr. using standard TxDOT approved fixtures and brackets.

Safety lighting is shown to be installed on the frontage road at all of the proposed entrance and exit ramps. The safety lighting will be standard 40 ft. breakaway base poles or bridge mounted mounts with 250 W TxDOT approved fixtures. 250 W TxDOT approved single arm poles and fixtures on 30 ft. poles were used on the SE-SW and WN-EN direct connectors. When the connectors go over the exit and entrance ramps or where the connectors merge, a second arm and fixture will be used for safety lighting of the ramp.

In the lighting design, a 250 W HPS luminaire on a 30 ft. pole was used for the direct connector lighting assembly, a 400 W HPS luminaire on a 48 ft. pole for the continuous median lighting assembly, a 250 W HPS luminaire on a 40 ft. pole for the lighting assembly along entrance/exit ramps and the frontage road side of mainlanes, and a 150 W HPS luminaire for understructure lighting fixtures.

7.1.4 Electrical System

For the majority of the project, CPS Energy has distribution lines along each side of the project right-of-way. The electrical services for the roadway illumination will connect to the CPS Energy network. This project will use 240/280 volt electrical services that have 480 volt circuits for the continuous and understructure lighting and 240 volt circuits for the signal light fixtures. For this project, voltage drop calculations according to the TxDOT *Highway Illumination Manual* on all of the circuits need to be performed.

7.2 Signing

The signs were designed in accordance with the 2011 *Texas Manual on Uniform Traffic Control Devices* (MUTCD) and the TxDOT *Freeway Signing Handbook*, October 2008 version. US 281 within the limits of this project is a controlled access facility with managed lanes, general purpose lane, and frontage roads. The US 281 managed lanes and general purposes lanes will be a high volume, high-speed facility with urban signing characteristics. All large guide signs were design to be on overhead sign bridge supports.

The TxDOT San Antonio District has developed Urban Design Themes for roadway construction. This project is located within the boundaries that will follow the Hill Country Region Standards under the San Antonio District Urban Design Themes. The design of the OSBs and COSSs will follow the Hill Country Region Standards provided by TxDOT San Antonio District.

There are existing large signs (overhead and ground mounted) along Loop 1604 for the US 281 Interchange that will need to be replaced to accommodate the new connectors. The Loop 1604 signs are illustrated in an attachment to this document. During the construction of the ES-EN direct connector for the Loop 1604 US 281 Interchange, one of the bents was designed to accommodate an overhead sign bridge (OSB) to be constructed when the EN connector was built. The WN direct connector was not designed to accommodate an OSB or cantilever overhead sign support (COSS) for the exit direction sign for the US 281 South and US 281 North split. The sign supports for this location was anticipated to be constructed adjacent to the WS-WN direct connector. If the existing overhead sign structures on Loop 1604 need to be replaced to accommodate the revised signs, the overhead sign structures may be replaced with steel truss columns or steel pipe columns.

The exit ramp signing was designed to have a 1 mile and ½ mile advance signs and an exit directional sign. In accordance with Figures 5-28 and 5-29 of the *Freeway Signing Handbook*, the signing for entrance exit ramp combinations was designed with auxiliary lanes based on the distance between theoretical gores. Therefore, most of these locations do not have the "Exit Only" message on them. The destination message on these signs contained the arterial street names on them. For an exit ramp with multiple street names, the name of the first arterial was placed at the top of the panel. When an arterial had different names on either side of the facility, the street name for the left side was placed at the top of the panel. As mentioned above, the sign supports were designed to be overhead. Typically the OSBs/COSSs for the exit directional signs were placed within 200 ft. of the theoretical gore. Due to the location of the theoretical gores some of the OSBs/COSSs were placed on bridge bents. The sign layouts and locations are shown on the schematics.

Depending on how the managed lanes are to be operated, the banner at the top of the managed lane signing is either "Toll Lane" or "Express Lane". The difference between the two messages is an "Express Lane" has an HOV free operation for a portion of the day and a "Toll Lane" provides for a discount to HOVs. As the manage lane operation has not been determined, the manage lane signing was designed with the "Toll Lane" banner. If the MUTCD changes or the managed lane operation is determined, the banner may need to be changed.

7.3 Intelligent Transportation Systems (ITS)

There were no ITS elements designed for this project.

7.4 Development of Traffic Projections

The TxDOT Transportation Planning and Programming Division (TPP) developed Year 2018, 2038 and 2048 traffic projections for the US 281 preferred alternative. The Traffic Projections dated March 7, 2014 were received by Jacobs on March 12, 2014. These traffic projections included a K-factor of 8.2%. Using the K-factor, design hourly volumes (DHV) for both the Opening Year (2018) and Design Year (2038) were determined.

In 2038, the traffic projections for the managed lanes between Loop 1604 and Stone Oak Parkway showed 26,800 vehicles per day in each direction. Using the K-factor, the peak DHV for the managed lanes is approximately 2,200 vehicles per hour (VPH).

For congested corridors, empirical research on managed lanes has shown that these lanes need to operate between 1400 VPH and 1700 VPH to provide benefits to the vehicles within the lane. Therefore, the 2038 DHV for the managed lane using the TPP traffic projections was too high.

A sensitivity test was performed on the managed lanes traffic volumes to determine the appropriate volume for the operational analysis. Initially, the TPP traffic volumes were redistributed from the managed lane to the general purpose lanes to achieve 1600 vph within the managed lane. Then, the densities of the general purpose lanes were compared between the 2200 VPH and 1600 VPH on the managed lanes for significant differences and operational benefits. Based upon the differences, the managed lanes traffic volume that would maintain the desired operational benefit was estimated. Finally, the TPP traffic volumes from the managed lane to the general purpose lanes were redistributed to achieve 700 VPH in the managed lane.

7.4.1 Operational Analysis Methodology

The daily traffic projections for each element for US 281 was provided by TPP for the Year 2018, 2038, and 2048. These projections are in the Attachments. The DHV were developed by using the 8.2% K-factor and are the basis for the traffic operation analyses on the corridor.

The 2010 Edition of the *Highway Capacity Manual (HCM2010)* prescribes procedures to analyze freeway corridors and ancillary facilities and also defines the Measures of Effectiveness (MOE) used to analyze traffic operating conditions. However, a shortcoming of *HCM2010* procedures is that it does not fully consider the traffic interaction between different elements of a highway corridor nor fully account for the congestion effect an upstream highway element may have on a downstream element. Therefore, the microscopic simulation tool, VISSIM, was used to evaluate the US 281 corridor for open and design year analyses.

Traffic signals were coded in Synchro to develop appropriate phasing and timing information at each intersection in the 2018 year and 2038 year Synchro models. These signal phasing and timings were used in the VISSIM models.

The level of service (LOS) for the study corridor was then estimated using the MOEs and the *HCM2010* guidelines to analyze the operating conditions. LOS is a quantifiable set of operating conditions which describe the relative ease or difficulty for completing a vehicle trip on a particular roadway. The highest LOS “A” is where there is virtually no constraint to the progress of a vehicle trip, where speeds are fairly uniform and high, and the density and total volume of traffic is low. The lowest LOS “F” is characterized by frequent stops and speeds changes with high densities of traffic. The acceptable LOS for the US 281 traffic operation analysis is LOS “D” for the basic freeway segments and LOS “D” for the ramps, weaving areas, frontage roads, and intersections.

There is a small difference to the preliminary design schematic between the opening and the design years. The description of the preferred alternative mentioned above is the design year geometry. The opening year has two managed full access-controlled main lanes in each direction from North of Marshall to Bexar/Comal County line.

As no plans exist for the future roadway configurations of Marshall, Northwind, Wilderness Future, and Overlook Future, two through lanes and right turn lane configurations approach the US 281 frontage roads.

7.4.2 VISSIM Analysis

Opening Year (2018) and Design Year (2038) traffic operations along the US 281 corridor between Loop 1604 and the Bexar/Comal County Line was studied using VISSIM microscopic simulation software (version 5.4-12).

VISSIM is a microscopic, time-step and behavior-based simulation software developed to model urban traffic and public transit operations. The program analyzes traffic and transit operations under a series of adjustable parameters such as lane configuration, traffic composition, traffic control devices, and transit stops, among others. For traffic operations, it can provide a diverse array of MOEs such as average total delay, travel times, and densities.

Using the following steps, the VISSIM models were developed to analyze the 2018 and 2038 preliminary design schematic of the study corridor:

- Scaled and imported the AutoCAD drawing of the corridor as the background;
- Developed network geometry (number of lanes, lane widths, acceleration/deceleration lane lengths, lane closures);
- Coded desired speed decisions;
- Coded reduced speed areas where appropriate;
- Coded priority rules where appropriate;
- Coded traffic signal controllers and traffic signal heads;
- Coded traffic signal timings, optimized using Synchro to accommodate 2018 and 2038 volumes (created *.rbc signal controller files);
- Coded input volumes and routing decisions; and
- Coded travel time segments (one in the northbound direction from Loop 1604 to the Bexar / Comal County line and the other in the southbound direction from the Bexar / Comal County line to Loop 1604).

In order to ensure an accurate replication of the congestion occurring during the peak hour, a 15 min pre-load period is included as a standard practice in microscopic simulation, and is recommended and preferred by Federal Highway Administration (FHWA).

It should be noted that, both VISSIM models (2018 and 2038) were run for ten (10) simulation runs with different seed numbers. The MOEs were extracted from the multiple simulation runs and their results averaged before comparing with the input volumes, thus minimizing the chance of outliers yielded by the stochastic element of the software. Furthermore, to prevent the bias caused by an initially empty network, MOEs were collected only after the simulation had run for 15 minutes (0-900 seconds of warm up time). MOEs were then collected for the design one-hour peak period (i.e. 60 minutes between 900 – 4500 seconds).

Both VISSIM models (2018 and 2038) used the car following and lane-changing parameters that are included in the Attachments to this memorandum.

7.4.3 2018 Design Schematic Analysis

During the 2018 Design Peak Hour, the results of the VISSIM analysis show decent speeds in the study corridor both in the northbound and southbound directions, with the proposed improvements in place. Similarly, densities and LOS along the study corridor were shown to be at acceptable levels. The entire study corridor was found to operate at LOS “B” or better, except (1) the freeway segment in the southbound direction between the Encino entrance ramp and the exit ramp to the Loop 1604 Direct Connect ramps (DCs) and (2) the southbound entrance ramp from Sonterra Boulevard, both of which operate at LOS “C.”

Output (processed) volumes were collected in VISSIM for the design peak hour to ensure that the input (demand) volume on the proposed roadway network enters the system and is used by VISSIM. The VISSIM model was able to process 99% of the demand volume in the study corridor.

In addition to the analysis of the main lanes, intersection analysis of the proposed cross streets was also performed for the preferred schematic. The results from the VISSIM analysis show that all of the cross street intersections and approaches are anticipated to operate at a LOS “C” or better with the proposed improvements in place, except some of the approaches at the intersections of Marshall Road and Stone Oak Parkway with the frontage roads, which are anticipated to operate at LOS “D”.

7.4.4 2038 Design Schematic Analysis

During the 2038 Design Peak Hour, the results of the VISSIM analysis show decent speeds in the study corridor both in the northbound and southbound directions. Similarly, densities and LOS along the study corridor are at acceptable levels. The northbound roadway segments are anticipated to operate at LOS “C” or better throughout the study corridor, with the proposed improvements in place, except (1) the freeway segment in the southbound direction between the entrance ramp from Encino Drive and the exit ramp to the Loop 1604 DCs, and (2) upstream of the Sonterra Boulevard exit ramp. The northbound direction, SB On-ramp from Stone Oak, and NB Off-ramp to Stone Oak operate at LOS “D”.

Output (processed) volumes were collected in VISSIM for the design peak hour to ensure that the input (demand) volume on the proposed roadway network enters the system and is used by VISSIM. The VISSIM model was able to process 99% of the demand volume in the study corridor.

In addition to the analysis of the main lanes, intersection analyses were performed for the proposed cross street intersections for the 2038 Design Peak Hour Volumes. The results from the VISSIM analysis shows that all of the cross street intersections and approaches are anticipated to operate at LOS “D” or better with the proposed improvements in place, except some of the approaches at the intersections of Stone Oak Boulevard and Marshall Road with the northbound and southbound frontage roads, which are anticipated to operate at LOS “E” and LOS “F.”

7.4.5 Travel Time Studies

Travel Time Studies were completed on May 7, 2014 for the US 281 Corridor. Two drivers made three runs each during the morning and evening rush hours using GPS-based travel time tablets. During the evening rush hour travel time study, traffic headed northbound into the study corridor was impeded by an accident near Bitters Road (3 miles south of the study corridor) which had traffic in two of the three lanes blocked. Also, this is the same night as one of the Spurs playoff games, which may have diverted some traffic away from a normal commute home. As a result, traffic congestion north of Loop 1604 was potentially less than a normal day. Travel times for the northbound direction would have likely increased if not for these events.

We compared true travel times versus those predicted by the 2018 and 2038 VISSIM models. In addition to processed volume, density, and speeds, travel times for the study corridor were defined along the main lanes for each direction in the VISSIM models (one in the northbound direction and one in the southbound direction, between Loop 1604 and the Bexar / Comal County line). There is an anticipated travel time savings of 48% in the northbound direction and 63% in the southbound direction, when compared to the existing conditions for both the 2018 and 2038 models, respectively.

8 DRAINAGE

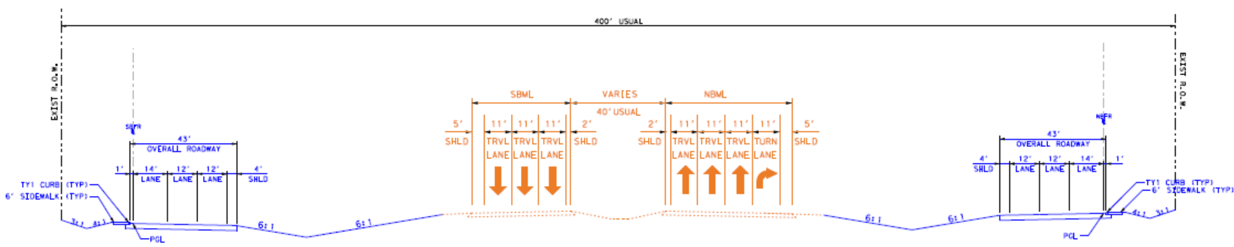
Drainage design and is documented in a separate report. Refer to the Jacobs *"Hydrologic and Hydraulic Analysis"* report for the US 281 Schematic.

9 TRAFFIC CONTROL PHASING

The Preferred Alternative Schematic was evaluated to determine a general phasing of construction. This phasing description is only intended to provide an overview of how traffic would be handled during the construction activities and is developed with the assumption that the entire corridor would be constructed under one contract, but perhaps in two phases. The phasing accounts for the current availability of Right-of-Way from LP 1604 to north of Stone Oak Parkway. Construction could begin on this first section while new Right-of-Way is acquired north of Stone Oak Parkway on the second section.

Phase 1: Loop 1604 to ½ mile north of Stone Oak Parkway

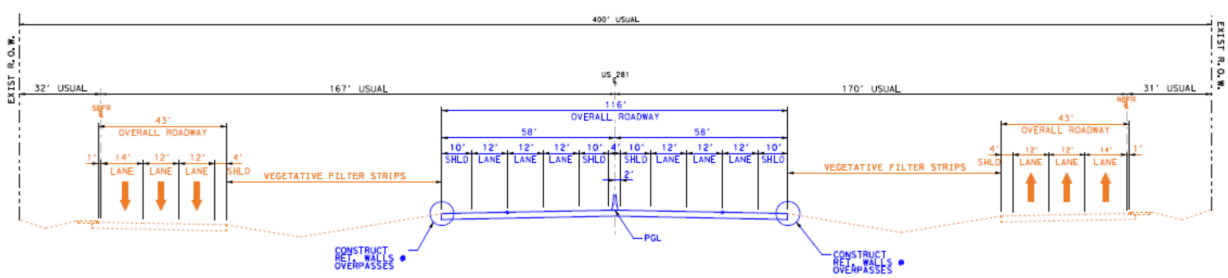
- Maintain traffic in existing location.
- Construct NB & SB frontage roads from Loop 1604 to ½ mile north of Stone Oak.
- Transition to existing US 281 configuration from ½ mile north of Stone Oak to Marshall Road.



PHASE 1 CONSTRUCTION:
SB AND NB US 281 ACCESS ROADS

Phase 2A: Loop 1604 to ½ mile north of Stone Oak Parkway

- Construct US 281 main lanes



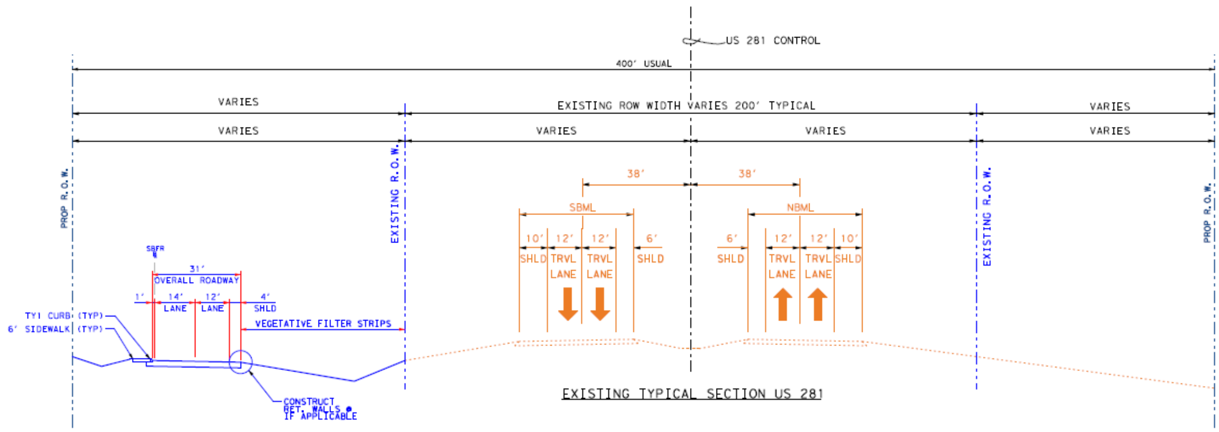
PHASE 2A CONSTRUCTION:
US 281 MAIN LANES

Phase 2B: Loop 1604/US 281 Interchange connectors

- Construct US 281/Loop 1604 Interchange connectors.
- Open Phase 2 main lanes to traffic.

Phase 3: From ½ mile north of Stone Oak Parkway to Borgfeld Road

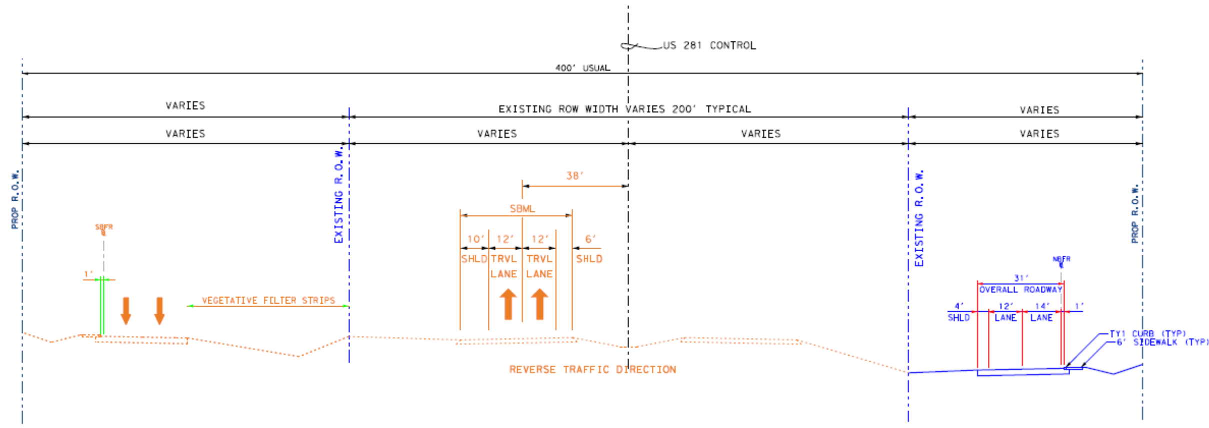
- Maintain traffic in existing location from ½ mile north of Stone Oak to Borgfeld.
- Construct Southbound US 281 access road.
- Construct street intersections left out in Phase 1.



PHASE 3 CONSTRUCTION:
SB US 281 ACCESS ROAD

Phase 4: From ½ mile north of Stone Oak Parkway to Borgfeld Road

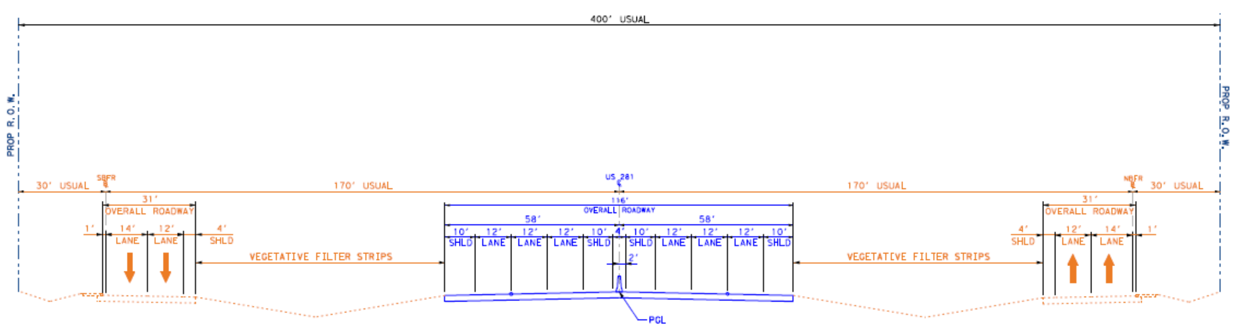
- Shift SB traffic to newly constructed SB access roads.
- Shift NB traffic to existing SB traffic lanes.
- Construct NB access road.



PHASE 4 CONSTRUCTION:
NB US 281 ACCESS ROAD

Phase 5: From ½ mile north of Stone Oak Parkway to Borgfeld Road

- Shift NB traffic to newly constructed NB access roads.
- Construct US 281 main lanes.



PHASE 5 CONSTRUCTION;
US 281 MAIN LANES

Phase 6: From ½ mile north of Stone Oak Parkway to Borgfeld Road

- Construct street intersections from Phase 2.

10 CONSTRUCTION ESTIMATE

For the purposes of estimating the project cost, various pavement combinations were considered. Using the ARIAS & Associates *Geotechnical Engineering Study*, the project costs were estimated using:

1) All Portland Concrete Pavement – 12” CRCP on the Main Lanes and Ramps & 9” CRCP on the Frontage Roads and Cross Streets;

2) A combination of Portland Concrete Pavement and Asphaltic Concrete Pavement – 12” CRCP on the Main Lanes and the Ramps & 17 ½” ACP on the Frontage Roads and Cross Streets; and

3) All Asphaltic Concrete Pavement – 22 ½” on the Main Lanes and Ramps & 17 ½” on the Frontage Roads.

While any combination of these pavement strategies may meet the project needs, further pavement design should be performed to identify the most feasible for the construction and appropriate for the US 281 pavement life-cycle.

The Project Cost Estimate reflects the schematic documents prepared June 19, 2014 and of those elements associated with the complete project development as described in the table below. These should be considered as the Engineer’s Opinions of Probable Costs based upon the Portland concrete (concrete) and hot mixed asphaltic concrete (HMAC) pavement strategies in the table below. The schematic developed for the Preferred Expressway Alternative is a further refinement of the Expressway Alternative described in the Draft EIS, April 2013.

The summary table below provides cost estimates for the interim and the final configuration of the Preferred Expressway Alternative and for three different pavement conditions. The interim and the ultimate configurations are the same from Loop 1604 to Stone Oak Parkway. From Stone Oak Parkway to Borgfeld, the interim configuration consists of two main lanes in each direction (northbound and southbound). The ultimate configuration would include a third main lane in each direction (northbound and southbound). The third lanes are an additional 24 foot width of pavement for 13,379 LF (35,677 SY). The cost estimates assume that the main lane bridges will be built full width in the interim phase of construction.

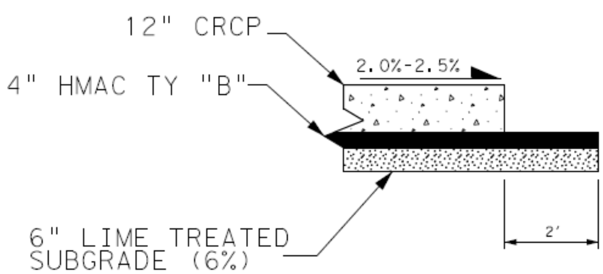
PHASE	DESCRIPTION	CONSTRUCTION COST	7% +/- ENGINEERING	10% +/- UTILITIES	ROW*	TOTAL Project Cost
ULTIMATE	ALL CONCRETE (ML and ACCESS RD)	$363,678,028	$26,000,000	$37,000,000	$32,000,000	$458,678,028
INTERIM	ALL CONCRETE (ML and ACCESS RD)	$359,330,739	$26,000,000	$37,000,000	$32,000,000	$454,330,739
ULTIMATE	CONCRETE (ML) AND HMAC (ACCESS RD)	$368,062,337	$26,000,000	$37,000,000	$32,000,000	$463,062,337
INTERIM	CONCRETE (ML) AND HMAC (ACCESS RD)	$363,715,047	$26,000,000	$37,000,000	$32,000,000	$458,715,047
ULTIMATE	ALL HMAC (ML AND ACCESS RD)	$381,078,325	$26,000,000	$37,000,000	$32,000,000	$476,078,325
INTERIM	ALL HMAC (ML AND ACCESS RD)	$375,982,644	$26,000,000	$37,000,000	$32,000,000	$470,982,644

Construction Quantities – Quantities were derived per the schematic design using MicroStation and Geopak applications. Areas were measured by their respective shape files or by direct calculations based on stationing and prescribed widths. All roadway alignments were defined with vertical and horizontal geometry per design criteria established for an Urban Principal Arterial Freeway with Collector Frontage Roads. Earthwork calculations were computed from cross sections reflective of the roadway geometry within the GEOPAK software. Substantial retaining walls were designed for this project due to the irregular ground surfaces from one side of the right-of-way (ROW) to the other. Drainage structures were sized from a detailed hydrologic study of the entire corridor which analyzed contributing drainage areas and resultant storm water flows. Most of the existing drainage structures were replaced due to new alignments and discharge points resulting from the realignment and widening of the roadway. Detention basins were also sized and provided along with filtration best management practices (BMPs) per the Texas Commission on Environmental Quality (TCEQ) regulations for the Edwards Aquifers' contributing and recharge zones. These drainage features have all been contained within the proposed ROW of the Preferred Expressway Alternative by either locating them beneath proposed bridge structures or below finished grade. Signing, striping, signals and other traffic-related items were determined per the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and Texas Department of Transportation (TxDOT) standard designs and have been included in the detailed quantities. Electronic Toll Equipment has not been quantified but is accounted for in the contingency.

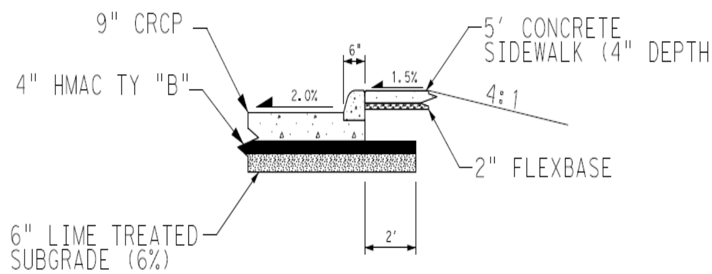
Construction Item Pricing – Unit prices are derived from the TxDOT Statewide 12-Month Average Bid Unit Bid Price and the San Antonio District 12-Month Average Bid Unit Price as of April 21, 2014. For a detailed summary of the quantity and unit costs developed, see the attached cost estimates.

Pavement Types - Three pavement structure types were considered for comparison of strategies. These pavement structures were derived from a previous Geotechnical Engineering Study prepared by Arias & Associates, November 2, 2007.

- All Portland Concrete – This strategy provides for a rigid Portland concrete pavement section for the main lanes, ramps, and frontage roads. The main lanes and ramps consist of 12" Continuous Reinforced Concrete Pavement (CRCP), 4" Type B Hot Mix Asphaltic Concrete Pavement (HMAC), and 6" Lime Treated Subgrade (LTS). The frontage roads consist of 9" CRCP, 4" Type B HMAC, and 6" LTS.

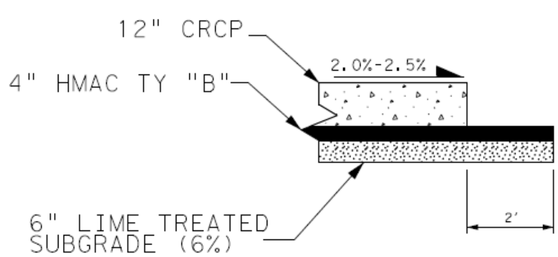


US 281 Mainlanes & Ramps (RIGID Pavement Design)

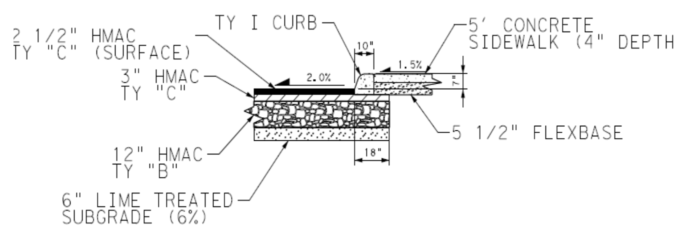


US 281 Frontage Roads (RIGID Pavement Design)

- Portland Concrete and HMAC – This strategy combines rigid and flexible pavement types. The main lanes and ramps consist of 12" CRCP, 4" Type B HMAC, and 6" LTS. The frontage roads consist of 5 ½" Type C HMAC, 12" Type B HMAC, and 6" LTS.

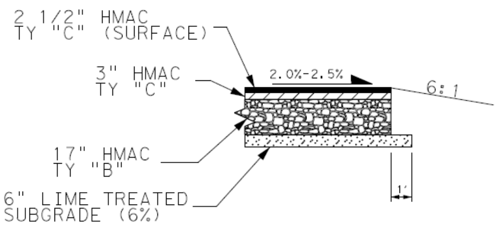


US 281 Mainlanes & Ramps (RIGID Pavement Design)

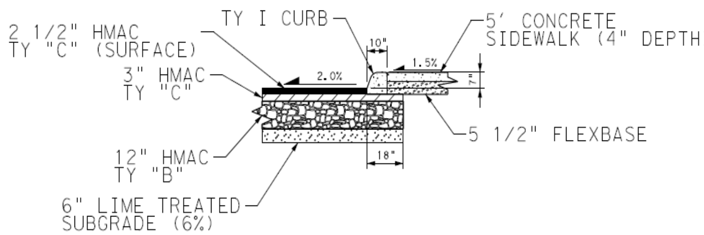


Frontage Roads & Intersecting Streets
(Flexible Pavement Design)

- All HMAC - This strategy provides a flexible asphaltic concrete pavement section for the main lanes, ramps, and frontage roads. The main lanes and the ramps consist of 5 ½” Type C HMAC, 17” Type B HMAC, and 6” LTS. The frontage roads consist of 5 ½” Type C HMAC, 12” Type B HMAC, and 6” LTS.

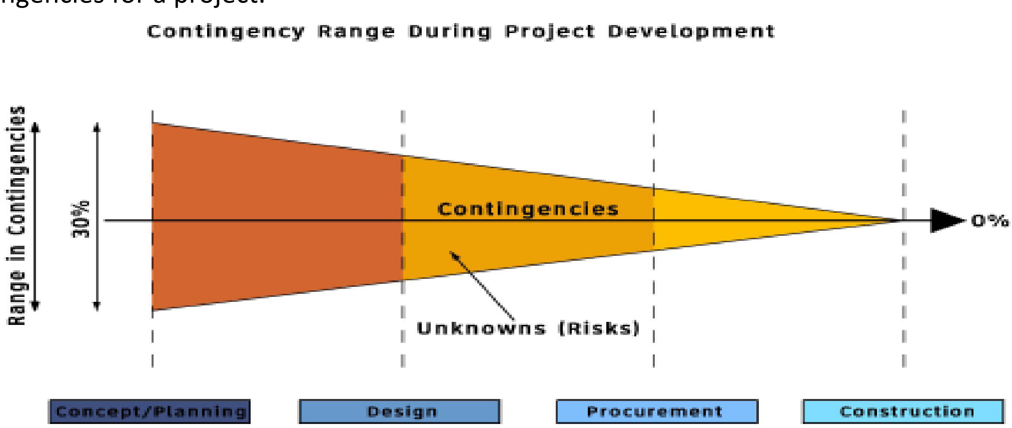


US 281 Mainlanes and Ramps
(Flexible Pavement Design)

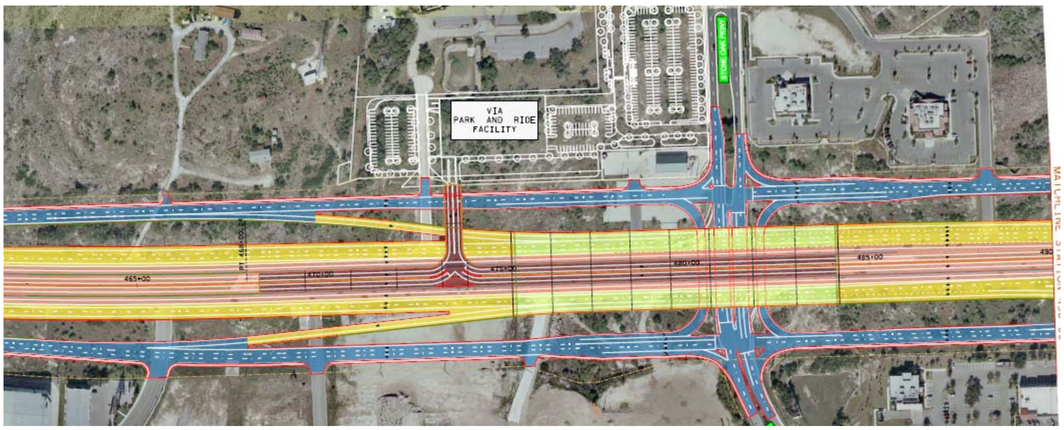


Frontage Roads and Intersecting Streets
(Flexible Pavement Design)

Contingency Factor – The contingency factor applied to this cost estimate is set at 20%. This is the normal range applied for projects when a detailed schematic has been developed and is in -line with about a 30% detailed design effort. Although many of the usual bid items have been accounted for, each item is subject to detailed design where specific quantities can be accounted. Two of the largest contributors to a project estimate include the pavement structure and the bridge configurations. These two items have received a higher level of scrutiny to identify specific limits and configurations. Additional review of the pavement structure can affect the cost depending upon the future design-builder’s means, methods, and material selection as well as the design life cycle target specified by the owner. It is typical at this stage of design to apply a contingency factor to account for costs that have not been defined or identified. As the design is further refined, the contingency factor will decrease and eventually become zero percent as the project is bid and moves into construction. The following figure illustrates the typical evolution of contingencies for a project.



VIA Transit Lane and Bridge - The VIA Metropolitan Transit is constructing a Park-n-Ride transit structure located at the southwest corner of Stone Oak Parkway and US 281. The US 281 Corridor Project would incorporate this multi-storied structure by constructing controlled access lanes from the north and southbound managed lanes, a bridge and a third level T-intersection leading to the top floor of the parking garage. The estimated construction cost of this feature is approximately $10.6 million, or about 3% of the US 281 Corridor Project construction cost.



US 281 T-intersection at VIA Park-n-Ride

Structural Bridge - Bridge Quantities were separated into four categories to better gauge the individual bridge types' cost per square foot in comparison with the TxDOT Bridge Division Average Bridge Type Cost per Square Foot. The categories included Direct Connector, Braided, Conventional, and the VIA structures. Each category has their own uniqueness resulting in slightly different unit costs. As a result, the overall bridge unit cost is estimated to be approximately $69/SF for 1,391,166 SF or $96 million total bridge cost.

Utilities – Utility adjustments are still being identified. At this current time, only above ground utilities have been identified in those areas where the realignment or widening of the US 281 facility are known to be in conflict. The most apparent of these is the electrical distribution ground running primarily along the west side from Marshall Road to the Bexar/Comal County line. The estimated cost is a factor of the construction cost.

ROW – The ROW costs were estimated based on a percentage of the land needed to be acquired and whether the existing improvements would need to be purchased. The parcel values come from the Bexar Appraisal District 2010 tax year data.

11 APPENDIX A- DETAILED CONSTRUCTION ESTIMATE

11.1 Ultimate Construction – Rigid Concrete Pavement Design Cost Estimate

ULTIMATE CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Ultimate ALL RIGID PAVEMENT Option				
Date:	5/7/2014				

ITEM	DESCRIPTION	QUANTITY	UNIT	SUGGESTED UNIT PRICE	PROJECT COST
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	189,309	LF	$ 45.00	$ 8,518,905.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
ULTIMATE - ALL RIGID PAVE DESIGN					
ULT. ML & RAMPS CONC PAVE DESIGN					
360 2005	CONC PVMT (CONT REINF - CRCP) (12")	618,175	SY	$ 54.50	$ 33,690,561.72
3268 2010	D-GR HMA TY-B PG70-22	135,999	TON	$ 68.00	$ 9,247,904.65
260 2001	LIME (HYDRATED LIME (DRY))	5,819	TON	$ 150.00	$ 872,846.85
260 2079	LIME TRT (SUBGRADE) (6")	646,553	SY	$ 1.75	$ 1,131,468.14
ULT. ACCESS RDS CONC PAVEMENT DESIGN					
360 2003	CONC PVMT (CONT REINF - CRCP) (10")	384,659	SY	$ 47.25	$ 18,175,127.25
3268 2010	D-GR HMA TY-B PG70-22	84,625	TON	$ 68.00	$ 5,754,495.32
260 2001	LIME (HYDRATED LIME (DRY))	3,818	TON	$ 150.00	$ 572,658.15
260 2079	LIME TRT (SUBGRADE) (6")	424,191	SY	$ 1.75	$ 742,334.64

ULTIMATE CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

DRAINAGE ESTIMATE							
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$	5.57	$	145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$	2.66	$	75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$	39.43	$	503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$	2.26	$	72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$	7.28	$	239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$	506.58	$	103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$	100.44	$	266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$	127.00	$	395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$	126.09	$	330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$	244.62	$	418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$	233.66	$	460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$	249.66	$	326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$	401.85	$	249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$	420.37	$	307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$	715.10	$	419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$	47.45	$	1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$	79.41	$	54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$	2,529.34	$	470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$	3,700.00	$	225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$	6,000.00	$	1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$	6,863.15	$	267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$	5,237.49	$	460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$	8,554.55	$	8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$	9,408.19	$	282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$	17,076.75	$	170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$	27,087.47	$	54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$	624.36	$	45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$	1,791.74	$	8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$	40.00	$	193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$	15.00	$	330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$	15.00	$	29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$	127.00	$	1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$	160.06	$	3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$	244.62	$	3,999,537.00

ULTIMATE CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

TRAFFIC ESTIMATE					
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$ 0.30	$ 73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$ 0.85	$ 137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$ 0.40	$ 26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$ 0.75	$ 39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$ 5.00	$ 130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$ 0.32	$ 71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$ 1.00	$ 3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$ 1.10	$ 402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$ 0.75	$ 16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$ 6.00	$ 732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$ 5.00	$ 36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$ 5,000.00	$ 95,000.00
416 2029	30" FOUNDATION	1,010	LF	$ 160.00	$ 161,600.00
514 2006	SSCB TY 3	171	LF	$ 110.00	$ 18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$ 3,000.00	$ 300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$ 5,000.00	$ 5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$ 2,000.00	$ 198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$ 4,500.00	$ 27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$ 3,000.00	$ 339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$ 5,000.00	$ 145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$ 2,200.00	$ 8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$ 4,200.00	$ 512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$ 2,700.00	$ 16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$ 5,000.00	$ 125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$ 1,200.00	$ 249,600.00
	DIAMOND INTERSECTIONS	9	EA	$ 240,000.00	$ 2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$ 120,000.00	$ 120,000.00
650 XXXX	OSB 45' BM	2	EA	$ 16,000.00	$ 32,000.00
650 XXXX	OSB 80' BM	1	EA	$ 21,000.00	$ 21,000.00
650 XXXX	OSB 110' BM	1	EA	$ 44,000.00	$ 44,000.00
650 XXXX	OSB 115' BM	1	EA	$ 45,000.00	$ 45,000.00
650 XXXX	OSB 65'	2	EA	$ 18,000.00	$ 36,000.00
650 XXXX	OSB 75'	2	EA	$ 22,500.00	$ 45,000.00
650 XXXX	OSB 85'	2	EA	$ 23,000.00	$ 46,000.00
650 XXXX	OSB 95'	2	EA	$ 26,000.00	$ 52,000.00
650 XXXX	OSB 100'	3	EA	$ 36,000.00	$ 108,000.00
650 XXXX	OSB 110'	2	EA	$ 44,000.00	$ 88,000.00
650 XXXX	OSB 135'	2	EA	$ 60,000.00	$ 120,000.00
650 XXXX	OSB 150'	1	EA	$ 90,000.00	$ 90,000.00
650 XXXX	COSS 30'	15	EA	$ 15,000.00	$ 225,000.00
650 XXXX	COSS 35'	1	EA	$ 22,000.00	$ 22,000.00
650 XXXX	COSS 40'	6	EA	$ 21,000.00	$ 126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$ 4.00	$ 12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$ 21.00	$ 16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$ 19.00	$ 31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$ 663.00	$ 1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$ 19.00	$ 352,944.00

ULTIMATE CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

BRIDGE ESTIMATE					
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$ 10.00	$ 27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$ 10.00	$ 160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$ 145.00	$ 2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$ 200.00	$ 1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$ 420.00	$ 363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$ 750.00	$ 1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$ 675.00	$ 939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$ 909.50	$ 11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$ 690.00	$ 1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$ 1,070.00	$ 10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$ 16.00	$ 22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$ 159.00	$ 27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$ 1.50	$ 5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$ 2.15	$ 232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$ 45.00	$ 1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)				$ 8,500,000.00
MISCELLANEOUS CATEGORIES					
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS		$ 5,354,032.75
SW3P (1%)			LS		$ 2,677,016.37
TRAFFIC CONTROL (3%)			LS		$ 8,031,049.12
MOBILIZATION (7%)			LS		$ 19,301,288.05
CONTINGENCY (20%)					$60,613,004.71
US 281 CONSTRUCTION COST TOTAL:					**$363,678,028.26**

INTERIM CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Interim ALL RIGID PAVEMENT Option				
Date:	5/7/2014				

ITEM	DESCRIPTION	QUANTITY	UNIT	SUGGESTED UNIT PRICE	PROJECT COST
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	**175,930**	LF	$ 45.00	$ 7,916,850.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
INTERIM - ALL RIGID PAVE DESIGN					
INTERIM ML & RAMPS CONC PAVE DESIGN					
360 2005	CONC PVMT (CONT REINF - CRCP) (12")	582,498	SY	$ 54.50	$ 31,746,147.06
3268 2010	D-GR HMA TY-B PG70-22	128,150	TON	$ 68.00	$ 8,714,171.74
260 2001	LIME (HYDRATED LIME (DRY))	5,471	TON	$ 150.00	$ 820,668.75
260 2079	LIME TRT (SUBGRADE) (6")	607,903	SY	$ 1.75	$ 1,063,829.86
INTERIM ACCESS RDS CONC PAVEMENT DESIGN					
360 2003	CONC PVMT (CONT REINF - CRCP) (10")	384,659	SY	$ 47.25	$ 18,175,127.25
3268 2010	D-GR HMA TY-B PG70-22	84,625	TON	$ 68.00	$ 5,754,495.32
260 2001	LIME (HYDRATED LIME (DRY))	3,818	TON	$ 150.00	$ 572,658.15
260 2079	LIME TRT (SUBGRADE) (6")	424,191	SY	$ 1.75	$ 742,334.64

11.2 Interim Construction - Rigid Concrete Pavement Design Cost Estimate

INTERIM CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

DRAINAGE ESTIMATE					
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$ 5.57	$ 145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$ 2.66	$ 75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$ 39.43	$ 503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$ 2.26	$ 72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$ 7.28	$ 239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$ 506.58	$ 103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$ 100.44	$ 266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$ 127.00	$ 395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$ 126.09	$ 330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$ 244.62	$ 418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$ 233.66	$ 460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$ 249.66	$ 326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$ 401.85	$ 249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$ 420.37	$ 307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$ 715.10	$ 419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$ 47.45	$ 1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$ 79.41	$ 54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$ 2,529.34	$ 470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$ 3,700.00	$ 225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$ 6,000.00	$ 1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$ 6,863.15	$ 267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$ 5,237.49	$ 460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$ 8,554.55	$ 8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$ 9,408.19	$ 282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$ 17,076.75	$ 170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$ 27,087.47	$ 54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$ 624.36	$ 45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$ 1,791.74	$ 8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$ 40.00	$ 193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$ 15.00	$ 330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$ 15.00	$ 29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$ 127.00	$ 1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$ 160.06	$ 3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$ 244.62	$ 3,999,537.00

INTERIM CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

TRAFFIC ESTIMATE					
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$ 0.30	$ 73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$ 0.85	$ 137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$ 0.40	$ 26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$ 0.75	$ 39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$ 5.00	$ 130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$ 0.32	$ 71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$ 1.00	$ 3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$ 1.10	$ 402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$ 0.75	$ 16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$ 6.00	$ 732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$ 5.00	$ 36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$ 5,000.00	$ 95,000.00
416 2029	30" FOUNDATION	1,010	LF	$ 160.00	$ 161,600.00
514 2006	SSCB TY 3	171	LF	$ 110.00	$ 18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$ 3,000.00	$ 300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$ 5,000.00	$ 5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$ 2,000.00	$ 198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$ 4,500.00	$ 27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$ 3,000.00	$ 339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$ 5,000.00	$ 145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$ 2,200.00	$ 8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$ 4,200.00	$ 512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$ 2,700.00	$ 16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$ 5,000.00	$ 125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$ 1,200.00	$ 249,600.00
	DIAMOND INTERSECTIONS	9	EA	$ 240,000.00	$ 2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$ 120,000.00	$ 120,000.00
650 XXXX	OSB 45' BM	2	EA	$ 16,000.00	$ 32,000.00
650 XXXX	OSB 80' BM	1	EA	$ 21,000.00	$ 21,000.00
650 XXXX	OSB 110' BM	1	EA	$ 44,000.00	$ 44,000.00
650 XXXX	OSB 115' BM	1	EA	$ 45,000.00	$ 45,000.00
650 XXXX	OSB 65'	2	EA	$ 18,000.00	$ 36,000.00
650 XXXX	OSB 75'	2	EA	$ 22,500.00	$ 45,000.00
650 XXXX	OSB 85'	2	EA	$ 23,000.00	$ 46,000.00
650 XXXX	OSB 95'	2	EA	$ 26,000.00	$ 52,000.00
650 XXXX	OSB 100'	3	EA	$ 36,000.00	$ 108,000.00
650 XXXX	OSB 110'	2	EA	$ 44,000.00	$ 88,000.00
650 XXXX	OSB 135'	2	EA	$ 60,000.00	$ 120,000.00
650 XXXX	OSB 150'	1	EA	$ 90,000.00	$ 90,000.00
650 XXXX	COSS 30'	15	EA	$ 15,000.00	$ 225,000.00
650 XXXX	COSS 35'	1	EA	$ 22,000.00	$ 22,000.00
650 XXXX	COSS 40'	6	EA	$ 21,000.00	$ 126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$ 4.00	$ 12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$ 21.00	$ 16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$ 19.00	$ 31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$ 663.00	$ 1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$ 19.00	$ 352,944.00

INTERIM CONSTRUCTION

RIGID CONCRETE PAVEMENT DESIGN

BRIDGE ESTIMATE					
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$ 10.00	$ 27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$ 10.00	$ 160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$ 145.00	$ 2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$ 200.00	$ 1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$ 420.00	$ 363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$ 750.00	$ 1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$ 675.00	$ 939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$ 909.50	$ 11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$ 690.00	$ 1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$ 1,070.00	$ 10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$ 16.00	$ 22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$ 159.00	$ 27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$ 1.50	$ 5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$ 2.15	$ 232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$ 45.00	$ 1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)				$ 8,500,000.00
MISCELLANEOUS CATEGORIES					
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS		$ 5,290,032.37
SW3P (1%)			LS		$ 2,645,016.18
TRAFFIC CONTROL (3%)			LS		$ 7,935,048.55
MOBILIZATION (7%)			LS		$ 19,070,566.68
CONTINGENCY (20%)					$59,888,456.42
US 281 CONSTRUCTION COST TOTAL:					**$359,330,738.51**

11.3 Ultimate Construction - Rigid Concrete and HMAC Pavement Design Cost Estimate

ULTIMATE CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Ultimate CONCRETE (ML) & HMAC (Access Rds) Option				
Date:	5/7/2014				

ITEM	DESCRIPTION	QUANTITY	UNIT	SUGGESTED UNIT PRICE	PROJECT COST
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	189,309	LF	$ 45.00	$ 8,518,905.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
ULTIMATE - MIXED RIGID AND FLEX PAVE DESIGN					
ULT. ML & RAMPS RIGID PAVE DESIGN					
360 2005	CONC PVMT (CONT REINF - CRCP) (12")	618,175	SY	$ 54.50	$ 33,690,561.72
3268 2010	D-GR HMA TY-B PG70-22	135,999	TON	$ 68.00	$ 9,247,904.65
260 2001	LIME (HYDRATED LIME (DRY))	5,819	TON	$ 150.00	$ 872,846.85
260 2079	LIME TRT (SUBGRADE) (6")	646,553	SY	$ 1.75	$ 1,131,468.14
ULT. ACCESS RD FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	52,891	TON	$ 72.00	$ 3,808,121.90
3268 2031	D-GR HMA TY-C PG76-22	68,361	TON	$ 70.00	$ 4,785,258.68
3268 2010	D-GR HMA TY-B PG70-22	273,443	TON	$ 68.00	$ 18,594,148.03
260 2001	LIME (HYDRATED LIME (DRY))	3,729	TON	$ 150.00	$ 559,315.95
260 2079	LIME TRT (SUBGRADE) (6")	414,308	SY	$ 1.75	$ 725,039.19

ULTIMATE CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

DRAINAGE ESTIMATE					
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$ 5.57	$ 145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$ 2.66	$ 75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$ 39.43	$ 503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$ 2.26	$ 72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$ 7.28	$ 239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$ 506.58	$ 103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$ 100.44	$ 266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$ 127.00	$ 395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$ 126.09	$ 330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$ 244.62	$ 418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$ 233.66	$ 460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$ 249.66	$ 326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$ 401.85	$ 249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$ 420.37	$ 307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$ 715.10	$ 419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$ 47.45	$ 1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$ 79.41	$ 54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$ 2,529.34	$ 470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$ 3,700.00	$ 225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$ 6,000.00	$ 1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$ 6,863.15	$ 267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$ 5,237.49	$ 460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$ 8,554.55	$ 8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$ 9,408.19	$ 282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$ 17,076.75	$ 170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$ 27,087.47	$ 54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$ 624.36	$ 45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$ 1,791.74	$ 8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$ 40.00	$ 193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$ 15.00	$ 330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$ 15.00	$ 29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$ 127.00	$ 1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$ 160.06	$ 3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$ 244.62	$ 3,999,537.00

ULTIMATE CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

TRAFFIC ESTIMATE					
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$ 0.30	$ 73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$ 0.85	$ 137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$ 0.40	$ 26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$ 0.75	$ 39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$ 5.00	$ 130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$ 0.32	$ 71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$ 1.00	$ 3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$ 1.10	$ 402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$ 0.75	$ 16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$ 6.00	$ 732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$ 5.00	$ 36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$ 5,000.00	$ 95,000.00
416 2029	30" FOUNDATION	1,010	LF	$ 160.00	$ 161,600.00
514 2006	SSCB TY 3	171	LF	$ 110.00	$ 18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$ 3,000.00	$ 300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$ 5,000.00	$ 5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$ 2,000.00	$ 198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$ 4,500.00	$ 27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$ 3,000.00	$ 339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$ 5,000.00	$ 145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$ 2,200.00	$ 8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$ 4,200.00	$ 512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$ 2,700.00	$ 16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$ 5,000.00	$ 125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$ 1,200.00	$ 249,600.00
	DIAMOND INTERSECTIONS	9	EA	$ 240,000.00	$ 2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$ 120,000.00	$ 120,000.00
650 XXXX	OSB 45' BM	2	EA	$ 16,000.00	$ 32,000.00
650 XXXX	OSB 80' BM	1	EA	$ 21,000.00	$ 21,000.00
650 XXXX	OSB 110' BM	1	EA	$ 44,000.00	$ 44,000.00
650 XXXX	OSB 115' BM	1	EA	$ 45,000.00	$ 45,000.00
650 XXXX	OSB 65'	2	EA	$ 18,000.00	$ 36,000.00
650 XXXX	OSB 75'	2	EA	$ 22,500.00	$ 45,000.00
650 XXXX	OSB 85'	2	EA	$ 23,000.00	$ 46,000.00
650 XXXX	OSB 95'	2	EA	$ 26,000.00	$ 52,000.00
650 XXXX	OSB 100'	3	EA	$ 36,000.00	$ 108,000.00
650 XXXX	OSB 110'	2	EA	$ 44,000.00	$ 88,000.00
650 XXXX	OSB 135'	2	EA	$ 60,000.00	$ 120,000.00
650 XXXX	OSB 150'	1	EA	$ 90,000.00	$ 90,000.00
650 XXXX	COSS 30'	15	EA	$ 15,000.00	$ 225,000.00
650 XXXX	COSS 35'	1	EA	$ 22,000.00	$ 22,000.00
650 XXXX	COSS 40'	6	EA	$ 21,000.00	$ 126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$ 4.00	$ 12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$ 21.00	$ 16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$ 19.00	$ 31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$ 663.00	$ 1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$ 19.00	$ 352,944.00

ULTIMATE CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

BRIDGE ESTIMATE					
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$ 10.00	$ 27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$ 10.00	$ 160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$ 145.00	$ 2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$ 200.00	$ 1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$ 420.00	$ 363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$ 750.00	$ 1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$ 675.00	$ 939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$ 909.50	$ 11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$ 690.00	$ 1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$ 1,070.00	$ 10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$ 16.00	$ 22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$ 159.00	$ 27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$ 1.50	$ 5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$ 2.15	$ 232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$ 45.00	$ 1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)				$ 8,500,000.00
MISCELLANEOUS CATEGORIES					
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS		$ 5,418,578.11
SW3P (1%)			LS		$ 2,709,289.06
TRAFFIC CONTROL (3%)			LS		$ 8,127,867.17
MOBILIZATION (7%)			LS		$ 19,533,974.10
CONTINGENCY (20%)					$61,343,722.82
US 281 CONSTRUCTION COST TOTAL:					**$368,062,336.92**

11.4 Interim Construction – Rigid Concrete and HMAC Pavement Design Cost Estimate

INTERIM CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Interim CONCRETE (ML) & HMAC (Access Rds) Option				
Date:	5/7/2014				

ITEM	DESCRIPTION	QUANTITY	UNIT	SUGGESTED UNIT PRICE	PROJECT COST
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	**175,930**	LF	$ 45.00	$ 7,916,850.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
INTERIM - MIXED RIGID AND FLEX PAVE DESIGN					
INTERIM ML & RAMPS RIGID PAVE DESIGN					
360 2005	CONC PVMT (CONT REINF - CRCP) (12")	582,498	SY	$ 54.50	$ 31,746,147.06
3268 2010	D-GR HMA TY-B PG70-22	128,150	TON	$ 68.00	$ 8,714,171.74
260 2001	LIME (HYDRATED LIME (DRY))	5,471	TON	$ 150.00	$ 820,668.75
260 2079	LIME TRT (SUBGRADE) (6")	607,903	SY	$ 1.75	$ 1,063,829.86
INTERIM ACCESS RD FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	52,891	TON	$ 72.00	$ 3,808,121.90
3268 2031	D-GR HMA TY-C PG76-22	68,361	TON	$ 70.00	$ 4,785,258.68
3268 2010	D-GR HMA TY-B PG70-22	273,443	TON	$ 68.00	$ 18,594,148.03
260 2001	LIME (HYDRATED LIME (DRY))	3,729	TON	$ 150.00	$ 559,315.95
260 2079	LIME TRT (SUBGRADE) (6")	414,308	SY	$ 1.75	$ 725,039.19
-	-	-	-	$ -	$ -

INTERIM CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

DRAINAGE ESTIMATE					
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$ 5.57	$ 145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$ 2.66	$ 75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$ 39.43	$ 503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$ 2.26	$ 72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$ 7.28	$ 239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$ 506.58	$ 103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$ 100.44	$ 266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$ 127.00	$ 395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$ 126.09	$ 330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$ 244.62	$ 418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$ 233.66	$ 460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$ 249.66	$ 326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$ 401.85	$ 249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$ 420.37	$ 307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$ 715.10	$ 419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$ 47.45	$ 1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$ 79.41	$ 54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$ 2,529.34	$ 470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$ 3,700.00	$ 225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$ 6,000.00	$ 1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$ 6,863.15	$ 267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$ 5,237.49	$ 460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$ 8,554.55	$ 8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$ 9,408.19	$ 282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$ 17,076.75	$ 170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$ 27,087.47	$ 54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$ 624.36	$ 45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$ 1,791.74	$ 8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$ 40.00	$ 193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$ 15.00	$ 330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$ 15.00	$ 29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$ 127.00	$ 1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$ 160.06	$ 3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$ 244.62	$ 3,999,537.00

INTERIM CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

TRAFFIC ESTIMATE					
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$ 0.30	$ 73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$ 0.85	$ 137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$ 0.40	$ 26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$ 0.75	$ 39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$ 5.00	$ 130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$ 0.32	$ 71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$ 1.00	$ 3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$ 1.10	$ 402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$ 0.75	$ 16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$ 6.00	$ 732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$ 5.00	$ 36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$ 5,000.00	$ 95,000.00
416 2029	30" FOUNDATION	1,010	LF	$ 160.00	$ 161,600.00
514 2006	SSCB TY 3	171	LF	$ 110.00	$ 18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$ 3,000.00	$ 300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$ 5,000.00	$ 5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$ 2,000.00	$ 198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$ 4,500.00	$ 27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$ 3,000.00	$ 339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$ 5,000.00	$ 145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$ 2,200.00	$ 8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$ 4,200.00	$ 512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$ 2,700.00	$ 16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$ 5,000.00	$ 125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$ 1,200.00	$ 249,600.00
	DIAMOND INTERSECTIONS	9	EA	$ 240,000.00	$ 2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$ 120,000.00	$ 120,000.00
650 XXXX	OSB 45' BM	2	EA	$ 16,000.00	$ 32,000.00
650 XXXX	OSB 80' BM	1	EA	$ 21,000.00	$ 21,000.00
650 XXXX	OSB 110' BM	1	EA	$ 44,000.00	$ 44,000.00
650 XXXX	OSB 115' BM	1	EA	$ 45,000.00	$ 45,000.00
650 XXXX	OSB 65'	2	EA	$ 18,000.00	$ 36,000.00
650 XXXX	OSB 75'	2	EA	$ 22,500.00	$ 45,000.00
650 XXXX	OSB 85'	2	EA	$ 23,000.00	$ 46,000.00
650 XXXX	OSB 95'	2	EA	$ 26,000.00	$ 52,000.00
650 XXXX	OSB 100'	3	EA	$ 36,000.00	$ 108,000.00
650 XXXX	OSB 110'	2	EA	$ 44,000.00	$ 88,000.00
650 XXXX	OSB 135'	2	EA	$ 60,000.00	$ 120,000.00
650 XXXX	OSB 150'	1	EA	$ 90,000.00	$ 90,000.00
650 XXXX	COSS 30'	15	EA	$ 15,000.00	$ 225,000.00
650 XXXX	COSS 35'	1	EA	$ 22,000.00	$ 22,000.00
650 XXXX	COSS 40'	6	EA	$ 21,000.00	$ 126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$ 4.00	$ 12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$ 21.00	$ 16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$ 19.00	$ 31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$ 663.00	$ 1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$ 19.00	$ 352,944.00

INTERIM CONSTRUCTION

RIGID CONCRETE AND HMAC DESIGN

BRIDGE ESTIMATE					
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$ 10.00	$ 27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$ 10.00	$ 160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$ 145.00	$ 2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$ 200.00	$ 1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$ 420.00	$ 363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$ 750.00	$ 1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$ 675.00	$ 939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$ 909.50	$ 11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$ 690.00	$ 1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$ 1,070.00	$ 10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$ 16.00	$ 22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$ 159.00	$ 27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$ 1.50	$ 5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$ 2.15	$ 232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$ 45.00	$ 1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)				$ 8,500,000.00
MISCELLANEOUS CATEGORIES					
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS		$ 5,354,577.73
SW3P (1%)			LS		$ 2,677,288.87
TRAFFIC CONTROL (3%)			LS		$ 8,031,866.60
MOBILIZATION (7%)			LS		$ 19,303,252.73
CONTINGENCY (20%)					$60,619,174.53
US 281 CONSTRUCTION COST TOTAL:					**$363,715,047.18**

11.5 Ultimate Construction – HMAC Pavement Design Cost Estimate

ULTIMATE CONSTRUCTION

HMAC DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Ultimate HMAC Option				
Date:	5/7/2014				

ITEM	DESCRIPTION	QUANTITY	UNIT	SUGGESTED UNIT PRICE	PROJECT COST
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	189,309	LF	$ 45.00	$ 8,518,905.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
ULTIMATE - ALL FLEX PAVEMENT DESIGN					
ULT. ML & RAMPS FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	84,999	TON	$ 72.00	$ 6,119,936.90
3268 2031	D-GR HMA TY-C PG76-22	101,999	TON	$ 70.00	$ 7,139,926.38
3268 2010	D-GR HMA TY-B PG70-22	577,994	TON	$ 68.00	$ 39,303,594.76
260 2001	LIME (HYDRATED LIME (DRY))	5,691	TON	$ 150.00	$ 853,691.85
260 2079	LIME TRT (SUBGRADE) (6")	632,364	SY	$ 1.75	$ 1,106,637.58
ULT. ACCESS RD FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	52,891	TON	$ 72.00	$ 3,808,121.90
3268 2031	D-GR HMA TY-C PG76-22	68,361	TON	$ 70.00	$ 4,785,258.68
3268 2010	D-GR HMA TY-B PG70-22	273,443	TON	$ 68.00	$ 18,594,148.03
260 2001	LIME (HYDRATED LIME (DRY))	3,729	TON	$ 150.00	$ 559,315.95
260 2079	LIME TRT (SUBGRADE) (6")	414,308	SY	$ 1.75	$ 725,039.19

ULTIMATE CONSTRUCTION

HMAC DESIGN

DRAINAGE ESTIMATE					
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$ 5.57	$ 145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$ 2.66	$ 75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$ 39.43	$ 503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$ 2.26	$ 72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$ 7.28	$ 239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$ 506.58	$ 103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$ 100.44	$ 266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$ 127.00	$ 395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$ 126.09	$ 330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$ 244.62	$ 418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$ 233.66	$ 460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$ 249.66	$ 326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$ 401.85	$ 249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$ 420.37	$ 307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$ 715.10	$ 419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$ 47.45	$ 1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$ 79.41	$ 54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$ 2,529.34	$ 470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$ 3,700.00	$ 225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$ 6,000.00	$ 1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$ 6,863.15	$ 267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$ 5,237.49	$ 460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$ 8,554.55	$ 8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$ 9,408.19	$ 282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$ 17,076.75	$ 170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$ 27,087.47	$ 54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$ 624.36	$ 45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$ 1,791.74	$ 8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$ 40.00	$ 193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$ 15.00	$ 330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$ 15.00	$ 29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$ 127.00	$ 1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$ 160.06	$ 3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$ 244.62	$ 3,999,537.00

ULTIMATE CONSTRUCTION

HMAC DESIGN

TRAFFIC ESTIMATE					
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$ 0.30	$ 73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$ 0.85	$ 137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$ 0.40	$ 26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$ 0.75	$ 39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$ 5.00	$ 130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$ 0.32	$ 71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$ 1.00	$ 3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$ 1.10	$ 402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$ 0.75	$ 16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$ 6.00	$ 732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$ 5.00	$ 36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$ 5,000.00	$ 95,000.00
416 2029	30" FOUNDATION	1,010	LF	$ 160.00	$ 161,600.00
514 2006	SSCB TY 3	171	LF	$ 110.00	$ 18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$ 3,000.00	$ 300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$ 5,000.00	$ 5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$ 2,000.00	$ 198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$ 4,500.00	$ 27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$ 3,000.00	$ 339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$ 5,000.00	$ 145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$ 2,200.00	$ 8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$ 4,200.00	$ 512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$ 2,700.00	$ 16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$ 5,000.00	$ 125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$ 1,200.00	$ 249,600.00
	DIAMOND INTERSECTIONS	9	EA	$ 240,000.00	$ 2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$ 120,000.00	$ 120,000.00
650 XXXX	OSB 45' BM	2	EA	$ 16,000.00	$ 32,000.00
650 XXXX	OSB 80' BM	1	EA	$ 21,000.00	$ 21,000.00
650 XXXX	OSB 110' BM	1	EA	$ 44,000.00	$ 44,000.00
650 XXXX	OSB 115' BM	1	EA	$ 45,000.00	$ 45,000.00
650 XXXX	OSB 65'	2	EA	$ 18,000.00	$ 36,000.00
650 XXXX	OSB 75'	2	EA	$ 22,500.00	$ 45,000.00
650 XXXX	OSB 85'	2	EA	$ 23,000.00	$ 46,000.00
650 XXXX	OSB 95'	2	EA	$ 26,000.00	$ 52,000.00
650 XXXX	OSB 100'	3	EA	$ 36,000.00	$ 108,000.00
650 XXXX	OSB 110'	2	EA	$ 44,000.00	$ 88,000.00
650 XXXX	OSB 135'	2	EA	$ 60,000.00	$ 120,000.00
650 XXXX	OSB 150'	1	EA	$ 90,000.00	$ 90,000.00
650 XXXX	COSS 30'	15	EA	$ 15,000.00	$ 225,000.00
650 XXXX	COSS 35'	1	EA	$ 22,000.00	$ 22,000.00
650 XXXX	COSS 40'	6	EA	$ 21,000.00	$ 126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$ 4.00	$ 12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$ 21.00	$ 16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$ 19.00	$ 31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$ 663.00	$ 1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$ 19.00	$ 352,944.00

ULTIMATE CONSTRUCTION

HMAC DESIGN

BRIDGE ESTIMATE							
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$	10.00	$	27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$	10.00	$	160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$	145.00	$	2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$	200.00	$	1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$	420.00	$	363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$	750.00	$	1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$	675.00	$	939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$	909.50	$	11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$	690.00	$	1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$	1,070.00	$	10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$	16.00	$	22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$	159.00	$	27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$	1.50	$	5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$	2.15	$	232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$	45.00	$	1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)					$	8,500,000.00
MISCELLANEOUS CATEGORIES							
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS			$	5,610,198.24
SW3P (1%)			LS			$	2,805,099.12
TRAFFIC CONTROL (3%)			LS			$	8,415,297.35
MOBILIZATION (7%)			LS			$	20,224,764.64
CONTINGENCY (20%)							$63,513,054.23
US 281 CONSTRUCTION COST TOTAL:							**$381,078,325.35**

11.6 Interim Construction – HMAC Pavement Design Cost Estimate

INTERIM CONSTRUCTION

HMAC DESIGN

Project:	US 281 Schematic (Loop 1604 to Borgfeld Rd)				
Estimate:	Final US 281 Construction Cost Estimate				
Option:	Interim HMAC Option				
Date:	5/7/2014				
ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**SUGGESTED UNIT PRICE**	**PROJECT COST**
ROADWAY ESTIMATE					
100 2002	PREPARING ROW	422	STA	$ 2,500.00	$ 1,055,000.00
105 2094	REMOVING STAB BASE & ASPH PAV(12"-27")	404,800	SY	$ 6.00	$ 2,428,800.00
110 2001	EXCAVATION (ROADWAY)	903,460	CY	$ 10.00	$ 9,034,600.00
132 2002	EMBANKMENT (FINAL)(DENS CONT)(TY A)	1,662,196	CY	$ 6.00	$ 9,973,176.00
420 2033	CL S CONC (APPR SLAB)	1,936	CY	$ 400.00	$ 774,400.00
423 2001	RETAINING WALL (MSE)	692,769	SF	$ 45.00	$ 31,174,605.00
423 2010	RETAINING WALL (ROCK NAILED)(FACIA)	30,860	SF	$ 60.00	$ 1,851,600.00
432 2001	RIPRAP (CONC)(4 IN)	2,402	CY	$ 330.00	$ 792,793.67
450 2013	RAIL (TY SSTR)	**175,930**	LF	$ 45.00	$ 7,916,850.00
529 2001	CONC CURB (TY I)	122,275	LF	$ 12.00	$ 1,467,296.40
529 2062	CONC CURB (TY C2)	38,700	LF	$ 80.00	$ 3,096,000.00
530 2010	DRIVEWAYS (CONC)	7,467	SY	$ 58.00	$ 433,086.00
530 2011	DRIVEWAYS (ACP)	7,300	SY	$ 30.00	$ 219,000.00
530 2012	DRIVEWAYS (SURF TREAT)	1,100	SY	$ 22.00	$ 24,200.00
531 2024	CONC SIDEWALK (5")	55,080	SY	$ 45.00	$ 2,478,600.00
545 XXXX	CRASH CUSHION ATTENUATORS	32	EA	$ 24,000.00	$ 768,000.00
INTERIM - ALL FLEX PAVEMENT DESIGN					
INTERIM ML & RAMPS FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	80,093	TON	$ 72.00	$ 5,766,731.30
3268 2031	D-GR HMA TY-C PG76-22	96,112	TON	$ 70.00	$ 6,727,853.18
3268 2010	D-GR HMA TY-B PG70-22	544,636	TON	$ 68.00	$ 37,035,229.90
260 2001	LIME (HYDRATED LIME (DRY))	5,357	TON	$ 150.00	$ 803,520.60
260 2079	LIME TRT (SUBGRADE) (6")	595,200	SY	$ 1.75	$ 1,041,600.78
INTERIM ACCESS RD FLEX PAVE DESIGN					
3268 2030	D-GR HMA TY-C SAC-B PG76-22	52,891	TON	$ 72.00	$ 3,808,121.90
3268 2031	D-GR HMA TY-C PG76-22	68,361	TON	$ 70.00	$ 4,785,258.68
3268 2010	D-GR HMA TY-B PG70-22	273,443	TON	$ 68.00	$ 18,594,148.03
260 2001	LIME (HYDRATED LIME (DRY))	3,729	TON	$ 150.00	$ 559,315.95
260 2079	LIME TRT (SUBGRADE) (6")	414,308	SY	$ 1.75	$ 725,039.19

INTERIM CONSTRUCTION

HMAC DESIGN

DRAINAGE ESTIMATE							
400 2002	STRUCT EXCAV (BOX)	26,127	CY	$	5.57	$	145,538.42
400 2003	STRUCT EXCAV (PIPE)	28,241	CY	$	2.66	$	75,020.36
400 2005	CEM STABIL BKFL	12,769	CY	$	39.43	$	503,475.94
402 2001	TRENCH EXCAVATION PROTECTION	32,044	LF	$	2.26	$	72,420.26
403 2001	TEMPORARY SPL SHORING	32,830	SF	$	7.28	$	239,002.40
430 2010	CL C CONC FOR EXT STRU(CULV)(5'X 5')	204	LF	$	506.58	$	103,343.05
460 2001	CMP (GAL STL 12 IN)	2,655	LF	$	100.44	$	266,668.20
462 2002	CONC BOX CULV (3 FT X 3 FT)	3,117	LF	$	127.00	$	395,859.00
462 2004	CONC BOX CULV (4 FT X 3 FT)	2,620	LF	$	126.09	$	330,355.80
462 2009	CONC BOX CULV (5 FT X 5 FT)	1,712	LF	$	244.62	$	418,789.44
462 2010	CONC BOX CULV (6 FT X 3 FT)	1,969	LF	$	233.66	$	460,076.54
462 2012	CONC BOX CULV (6 FT X 5 FT)	1,307	LF	$	249.66	$	326,305.62
462 2024	CONC BOX CULV (9 FT X 5 FT)	620	LF	$	401.85	$	249,147.00
462 2029	CONC BOX CULV (10 FT X 5 FT)	732	LF	$	420.37	$	307,708.34
462 2031	CONC BOX CULV (10 FT X 7 FT)	586	LF	$	715.10	$	419,048.60
464 2005	RC PIPE (CL III)(24 IN)	42,042	LF	$	47.45	$	1,994,884.36
464 2009	RC PIPE (CL III)(36 IN)	684	LF	$	79.41	$	54,316.44
465 2092	MANH (COMPL)(TY 1)	186	EA	$	2,529.34	$	470,457.24
465 2203	INLET (COMPL)(CTB)(TY S)	61	EA	$	3,700.00	$	225,700.00
465 2478	INLET (COMPL)(TY RWIR)	177	EA	$	6,000.00	$	1,062,000.00
465 2566	INLET (COMPL)(CURB)(TY I)	39	EA	$	6,863.15	$	267,662.94
465 2589	INLET (COMPL) (BRIDGE DECK DRAIN))	88	EA	$	5,237.49	$	460,899.44
466 2038	WINGWALL (FW-S)(HW=8 FT)	1	EA	$	8,554.55	$	8,554.55
466 2050	WINGWALL (PW)(HW=6 FT)	30	EA	$	9,408.19	$	282,245.70
466 2052	WINGWALL (PW)(HW=8 FT)	10	EA	$	17,076.75	$	170,767.50
466 2054	WINGWALL (PW)(HW=10 FT)	2	EA	$	27,087.47	$	54,174.94
467 2211	SET (TY II)(24 IN)(RCP)(3:1)(C)	73	EA	$	624.36	$	45,578.28
467 2215	SET (TY II)(36 IN)(RCP)(3:1)(C)	5	EA	$	1,791.74	$	8,958.70
481 2012	PVC PIPE (SCH 40)(6 IN)	4,828	LF	$	40.00	$	193,125.20
110 XXXX	EXCAVATION (SPECIAL) - DETENTION POND	22,055	CY	$	15.00	$	330,825.00
110 XXXX	EXCAVATION (SPECIAL) - WATER QUALITY POND	1,955	CY	$	15.00	$	29,325.00
462 2002	CONC BOX CULV (3 FT X 3 FT)	8,261	LF	$	127.00	$	1,049,147.00
462 2005	CONC BOX CULV (4 FT X 4 FT)	20,932	LF	$	160.06	$	3,350,375.92
462 2009	CONC BOX CULV (5 FT X 5 FT)	16,350	LF	$	244.62	$	3,999,537.00

INTERIM CONSTRUCTION

HMAC DESIGN

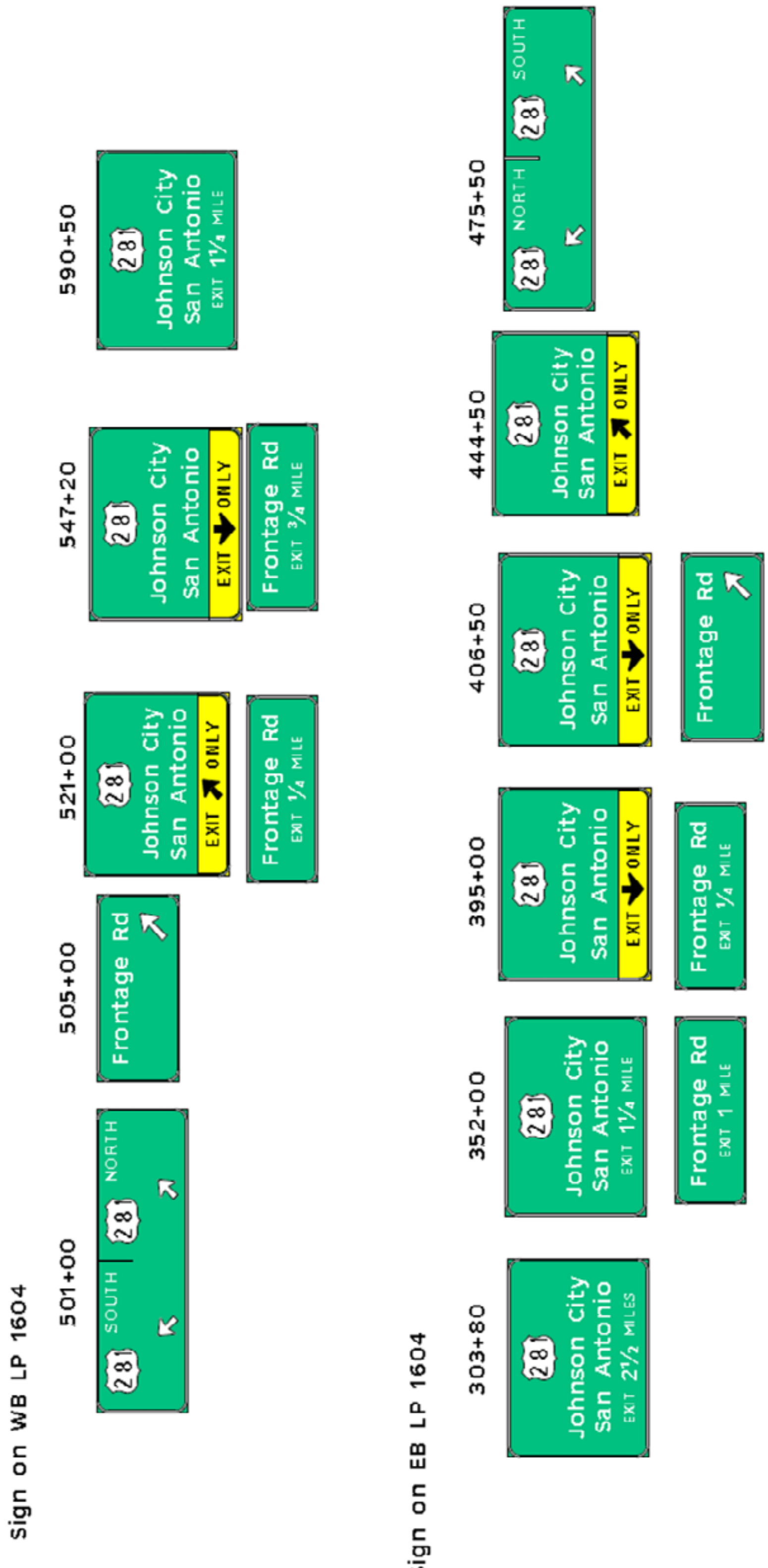
TRAFFIC ESTIMATE							
666 2012	REFL PAV MRK TY I (W) 4" (SLD) (100MIL)	244,618	LF	$	0.30	$	73,385.40
666 2006	REFL PAV MRK TY I (W) 4" (DOT) (100MIL)	162	LF	$	0.85	$	137.70
666 2003	REFL PAV MRK TY I (W) 4" (BRK) (100MIL)	66,630	LF	$	0.40	$	26,652.00
666 2036	REFL PAV MRK TY I (W) 8" (SLD) (100MIL)	52,679	LF	$	0.75	$	39,509.25
666 2048	REFL PAV MRK TY I (W) 24" (SLD) (100MIL)	26,102	LF	$	5.00	$	130,510.00
666 2111	REFL PAV MRK TY I (Y) 4" (SLD) (100MIL)	224,549	LF	$	0.32	$	71,855.68
666 2123	REFL PAV MRK TY I (Y) 8" (SLD) (100MIL)	3,579	LF	$	1.00	$	3,579.00
620 2012	ELEC CONDR (NO. 8) INSULATED	366,000	LF	$	1.10	$	402,600.00
620 2016	ELEC CONDR (NO. 12) INSULATED	22,000	LF	$	0.75	$	16,500.00
618 2018	CONDT (PVC) (SCHD 40) (2")	122,000	LF	$	6.00	$	732,000.00
618 2012	CONDT (PVC) (SCHD 40) (1")	7,300	LF	$	5.00	$	36,500.00
628 XXXX	ELECTRIC SERVICE	19	EA	$	5,000.00	$	95,000.00
416 2029	30" FOUNDATION	1,010	LF	$	160.00	$	161,600.00
514 2006	SSCB TY 3	171	LF	$	110.00	$	18,810.00
610 2025	INS RD IL AM (TY SA) 40T - 8 (.25 KW) S	100	EA	$	3,000.00	$	300,000.00
610 2026	INS RD IL AM (TY SA) 40T - 8 - 8 (.25 KW) S	1	EA	$	5,000.00	$	5,000.00
610 2020	INS RD IL AM (TY SA) 40B - 8 (.25 KW) S	99	EA	$	2,000.00	$	198,000.00
610 2021	INS RD IL AM (TY SA) 40B - 8 - 8 (.25 KW) S	6	EA	$	4,500.00	$	27,000.00
610 2022	INS RD IL AM (TY SA) 40S - 8 (.25 KW) S	113	EA	$	3,000.00	$	339,000.00
610 2023	INS RD IL AM (TY SA) 40S - 8 - 8 (.25 KW) S	29	EA	$	5,000.00	$	145,000.00
610 2036	INS RD IL AM (TY SA) 50S - 8 (.4 KW) S	4	EA	$	2,200.00	$	8,800.00
610 2037	INS RD IL AM (TY SA) 50S - 8 - 8 (.4 KW) S	122	EA	$	4,200.00	$	512,400.00
610 2027	INS RD IL AM (TY SA) 50B - 8 (.4 KW) S	6	EA	$	2,700.00	$	16,200.00
610 2028	INS RD IL AM (TY SA) 50B - 8 - 8 (.4 KW) S	25	EA	$	5,000.00	$	125,000.00
610 2062	INS RD IL AM (U / P) (TY 1) (.25KW) S	208	EA	$	1,200.00	$	249,600.00
	DIAMOND INTERSECTIONS	9	EA	$	240,000.00	$	2,160,000.00
	DIAMOND INTERSECTIONS (VIA INTERSECTION)	1	EA	$	120,000.00	$	120,000.00
650 XXXX	OSB 45' BM	2	EA	$	16,000.00	$	32,000.00
650 XXXX	OSB 80' BM	1	EA	$	21,000.00	$	21,000.00
650 XXXX	OSB 110' BM	1	EA	$	44,000.00	$	44,000.00
650 XXXX	OSB 115' BM	1	EA	$	45,000.00	$	45,000.00
650 XXXX	OSB 65'	2	EA	$	18,000.00	$	36,000.00
650 XXXX	OSB 75'	2	EA	$	22,500.00	$	45,000.00
650 XXXX	OSB 85'	2	EA	$	23,000.00	$	46,000.00
650 XXXX	OSB 95'	2	EA	$	26,000.00	$	52,000.00
650 XXXX	OSB 100'	3	EA	$	36,000.00	$	108,000.00
650 XXXX	OSB 110'	2	EA	$	44,000.00	$	88,000.00
650 XXXX	OSB 135'	2	EA	$	60,000.00	$	120,000.00
650 XXXX	OSB 150'	1	EA	$	90,000.00	$	90,000.00
650 XXXX	COSS 30'	15	EA	$	15,000.00	$	225,000.00
650 XXXX	COSS 35'	1	EA	$	22,000.00	$	22,000.00
650 XXXX	COSS 40'	6	EA	$	21,000.00	$	126,000.00
647 2001	INSTALL LRSS (STRUCT STEEL)	3,000	LB	$	4.00	$	12,000.00
636 2002	ALUMINUM SIGNS (TY G)	800	SF	$	21.00	$	16,800.00
636 2003	ALUMINUM SIGNS (TY O)	1,650	SF	$	19.00	$	31,350.00
420 2010	CL C CONC (SIGN COLUMN)	2,240	CY	$	663.00	$	1,485,120.00
626 2003	LARGE GUIDE SIGNS	18,576	SF	$	19.00	$	352,944.00

INTERIM CONSTRUCTION

HMAC DESIGN

BRIDGE ESTIMATE					
400 2004	STRUCT EXCAV (BRIDGE)	2,751	CY	$ 10.00	$ 27,508.90
403 2001	TEMPORARY SPL SHORING	16,054	SF	$ 10.00	$ 160,538.40
416 2004	DRILL SHAFT (36 IN)	16,347	LF	$ 145.00	$ 2,370,315.00
416 2006	DRILL SHAFT (48 IN)	8,717	LF	$ 200.00	$ 1,743,400.00
416 2010	DRILL SHAFT (72 IN)	865	LF	$ 420.00	$ 363,300.00
416 2047	DRILL SHAFT (96 IN)	1,409	LF	$ 750.00	$ 1,056,750.00
420 2003	CL C CONC (ABUT)	1,393	CY	$ 675.00	$ 939,951.20
420 2004	CL C CONC (BENT)	13,158	CY	$ 909.50	$ 11,967,201.00
420 2005	CL C CONC (FOOTING)	1,772	CY	$ 690.00	$ 1,222,680.00
420 2027	CL F CONC (BENT)	9,857	CY	$ 1,070.00	$ 10,546,990.00
422 2001	REINF CONC SLAB	1,391,166	SF	$ 16.00	$ 22,258,653.92
425 2068	PRESTR CONC GIRDER (TX54)	170,135	LF	$ 159.00	$ 27,051,465.00
442 2002	STR STL (PLATE GIRDER)	3,909,616	LB	$ 1.50	$ 5,864,424.00
442 2004	STR STL (BOX GIRDER)	108,039	LB	$ 2.15	$ 232,283.85
450 2013	RAIL (TY SSTR)	38,546	LF	$ 45.00	$ 1,734,570.00
	MISCELLANEOUS (SEJ, Conc Surf Trt, Misc Steel, Bearings, other items)				$ 8,500,000.00
MISCELLANEOUS CATEGORIES					
LANDSCAPING, FERTILIZING, SEEDING, MAINTENANCE (2%)			LS		$ 5,535,180.10
SW3P (1%)			LS		$ 2,767,590.05
TRAFFIC CONTROL (3%)			LS		$ 8,302,770.15
MOBILIZATION (7%)			LS		$ 19,954,324.27
CONTINGENCY (20%)					$62,663,773.93
US 281 CONSTRUCTION COST TOTAL:					**$375,982,643.57**

12 APPENDIX B– LOOP 1604 LARGE GUIDE SIGNS



13 APPENDIX C – TPP TRAFFIC DATA

Texas Department of Transportation

MEMO

March 7, 2014

To: Mario R. Jorge, P.E.
Attention: Jonathan Bean, P.E.

From: William E. Knowles, P.E.

Subject: Traffic Data
CSJ: 0253-04-138
US 281:
From Loop 1604
To Borgfeld

Bexar County

Attached are copies of schematics depicting 2018, 2038 and 2048 anticipated average daily traffic volumes and turning movements along US 281 for both existing and proposed conditions. Also attached are tabulations showing traffic analysis for highway design for the 2018 to 2038 twenty year period and 2018 to 2048 thirty year period for the described limits of the route. Included are tabulations showing data for use in air and noise analysis.

This data supersedes the information from the project provided to your office on January 31, 2014.

Due to significant differences in traffic volumes this project was separated into three sections.

Section 1: From Loop 1604 to Evans Road
Section 2: From Evans Road to Bulverde Road
Section 3: From Bulverde Road to Borgfeld Drive

Please refer to your original memorandum dated December 16, 2013. Revised schematics were received on January 9th, January 13th, and February 24th 2014 and are considered in this analysis. Only Free Flow traffic volumes are provided.

If you have any questions or need additional information, please contact Robert Williams at (512) 486-5145.

Attachments

CC: Melissa Bernal, San Antonio District
Design Division

OUR GOALS
MAINTAIN A SAFE SYSTEM • ADDRESS CONGESTION • CONNECT TEXAS COMMUNITIES • BEST IN CLASS STATE AGENCY

An Equal Opportunity Employer

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District — March 7, 2014

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2038	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038): Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 1												
From Loop 1604 To Evans Rd.	137,100	213,500	53 - 47	8.2	2.9	1.7	12,400	20	12,805,000	3	15,727,000	8"
Bexar County							12,400	20	12,805,000	3	16,104,000	13"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	97.1	98.3
Medium Duty	1.8	1.1
Heavy Duty	1.1	0.6

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2048	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048): Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 1												
From Loop 1604 To Evans Rd.	137,100	235,500	53 - 47	8.2	2.9	1.7	12,500	20	20,413,000	3	25,071,000	8"
Bexar County							12,500	20	20,413,000	3	25,672,000	13"

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 84704

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District

March 7, 2014

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2038	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038) Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 2												
From Evans Rd. To Bulverde Rd.	81,400	126,200	53 - 47	8.2	3.9	2.3	12,200	30	10,116,000	3	12,470,000	8"
							12,200	30	10,116,000	3	12,770,000	13"
Bexar County												

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	96.1	97.7
Medium Duty	2.4	1.4
Heavy Duty	1.5	0.9

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2048	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048) Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 2												
From Evans Rd. To Bulverde Rd.	81,400	139,900	53 - 47	8.2	3.9	2.3	12,300	30	16,175,000	3	19,940,000	8"
							12,300	30	16,175,000	3	20,420,000	13"
Bexar County												

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 34704

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District **March 7, 2014**

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2038	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038): Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 3												
From Bulverde Rd. To Borgfeld Dr.	47,800	74,100	53 - 47	8.2	4.3	2.6	12,000	30	6,535,000	3	8,063,000	8"
Bexar County							12,000	30	6,535,000	3	8,258,000	13"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	95.7	97.4
Medium Duty	2.6	1.6
Heavy Duty	1.7	1.0

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2048	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048): Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Existing Lane Configuration) Section 3												
From Bulverde Rd. To Borgfeld Dr.	47,800	82,600	53 - 47	8.2	4.3	2.6	12,000	30	10,486,000	3	12,939,000	8"
Bexar County							12,000	30	10,486,000	3	13,251,000	13"

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 34704

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District

March 7, 2014

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2038	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038) Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 1												
From Loop 1604	137,100	213,500	53 - 47	8.2	2.9	1.7	12,400	20	12,805,000	3	15,727,000	8"
To Evans Rd.							12,400	20	12,805,000	3	16,104,000	13"
Bexar County												

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	97.1	98.3
Medium Duty	1.8	1.1
Heavy Duty	1.1	0.6

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2048	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048) Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 1												
From Loop 1604	137,100	235,500	53 - 47	8.2	2.9	1.7	12,500	20	20,413,000	3	25,071,000	8"
To Evans Rd.							12,500	20	20,413,000	3	25,672,000	13"
Bexar County												

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BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 34704

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District | March 7, 2014

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2038	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038): Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 2												
From Evans Rd. To Bulverde Rd.	97,100	151,300	53 - 47	8.2	3.5	2.1	12,300	30	10,891,000	3	13,409,000	8"
Bexar County							12,300	30	10,891,000	3	13,732,000	13"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	96.5	97.9
Medium Duty	2.1	1.3
Heavy Duty	1.4	0.8

Description of Location	Average Daily Traffic 2018	Average Daily Traffic 2048	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048): Flexible Pavement	SN	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 2												
From Evans Rd. To Bulverde Rd.	97,100	167,200	53 - 47	8.2	3.5	2.1	12,300	20	17,382,000	3	21,401,000	8"
Bexar County							12,300	20	17,382,000	3	21,915,000	13"

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 347

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District

March 7, 2014

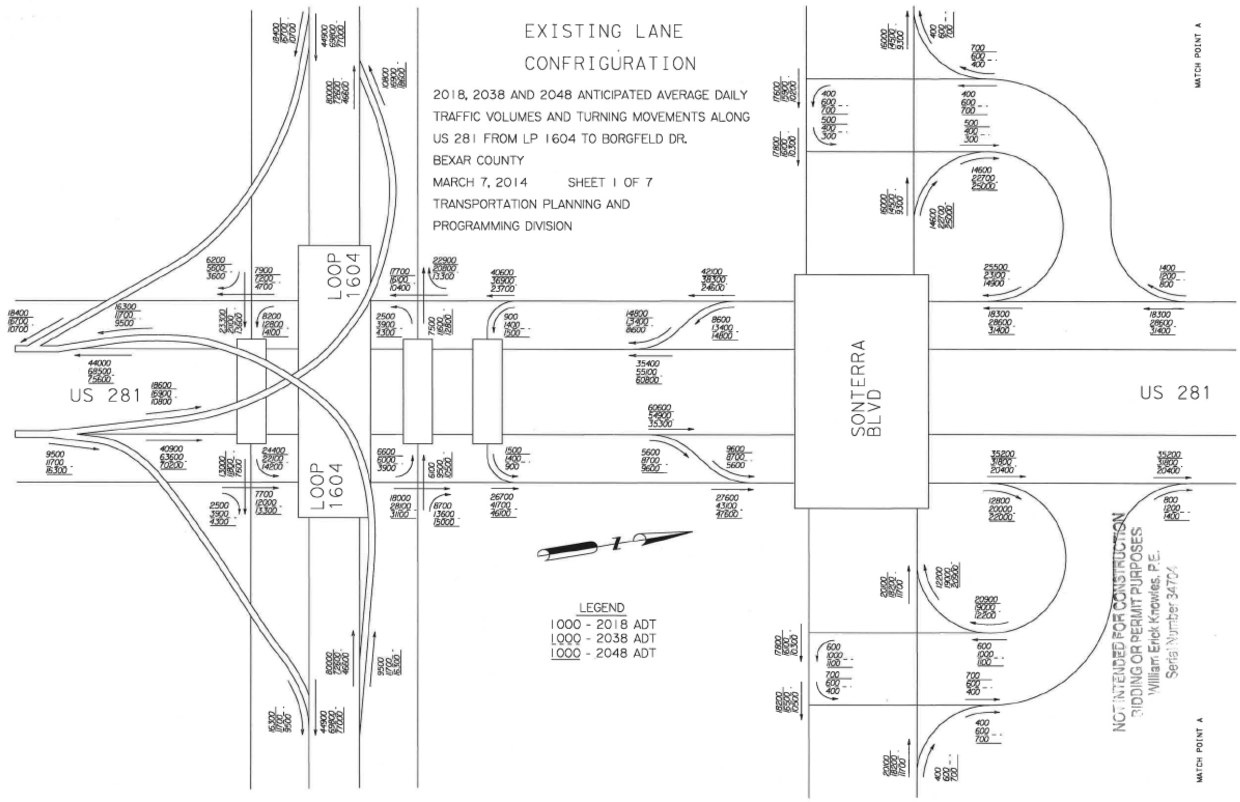
Description of Location	Base Year: Average Daily Traffic 2018	Average Daily Traffic 2038	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2018 to 2038): Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 3												
From Bulverde Rd. To Borgfeld Dr.	52,400	82,000	53 - 47	8.2	4.4	2.6	12,000	30	7,368,000	3	9,094,000	8"
Bexar County							12,000	30	7,368,000	3	9,314,000	13"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year: % of ADT	% of DHV
Light Duty	95.6	97.4
Medium Duty	2.7	1.6
Heavy Duty	1.7	1.0

Description of Location	Base Year: Average Daily Traffic 2018	Average Daily Traffic 2048	Dir Dist %	K Factor	Percent Trucks ADT	Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2018 to 2048): Flexible Pavement	S N	Rigid Pavement	SLAB
US 281 (Proposed Lane Configuration) Section 3												
From Bulverde Rd. To Borgfeld Dr.	52,400	90,400	53 - 47	8.2	4.4	2.6	12,100	30	11,743,000	3	14,494,000	8"
Bexar County							12,100	30	11,743,000	3	14,844,000	13"

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 84704

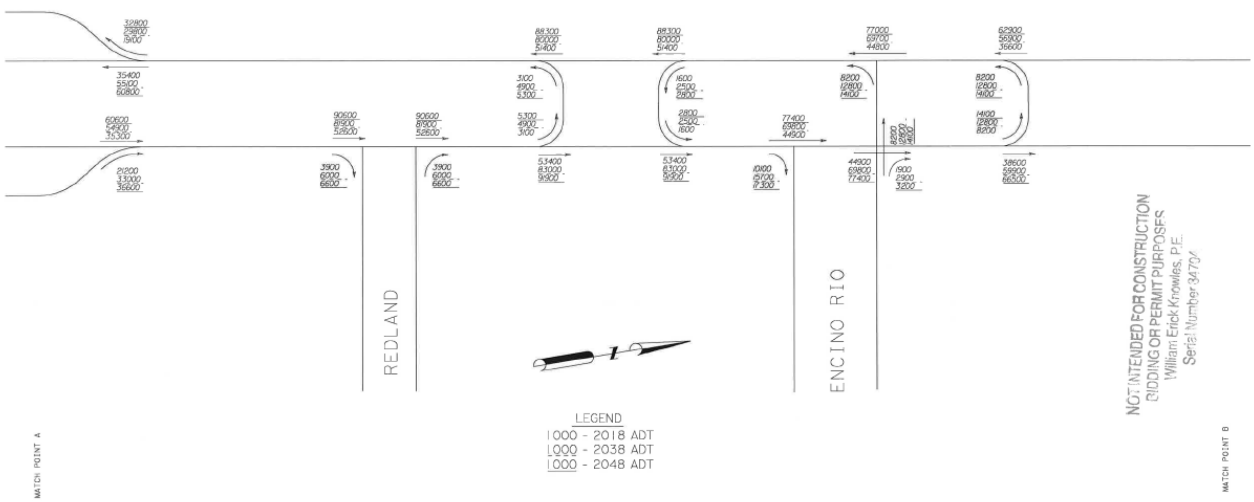


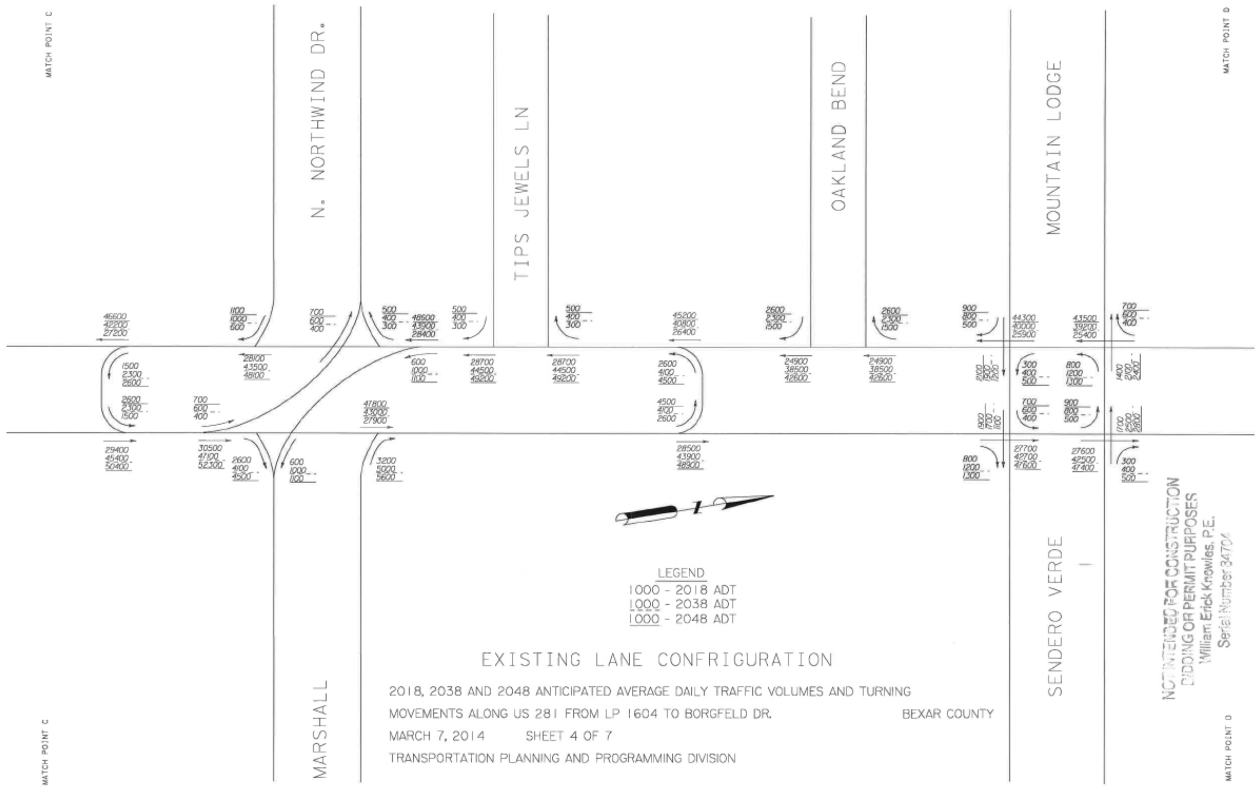
EXISTING LANE CONFRIGURATION

2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR. BEXAR COUNTY

MARCH 7, 2014 SHEET 2 OF 7

TRANSPORTATION PLANNING AND PROGRAMMING DIVISION

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MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
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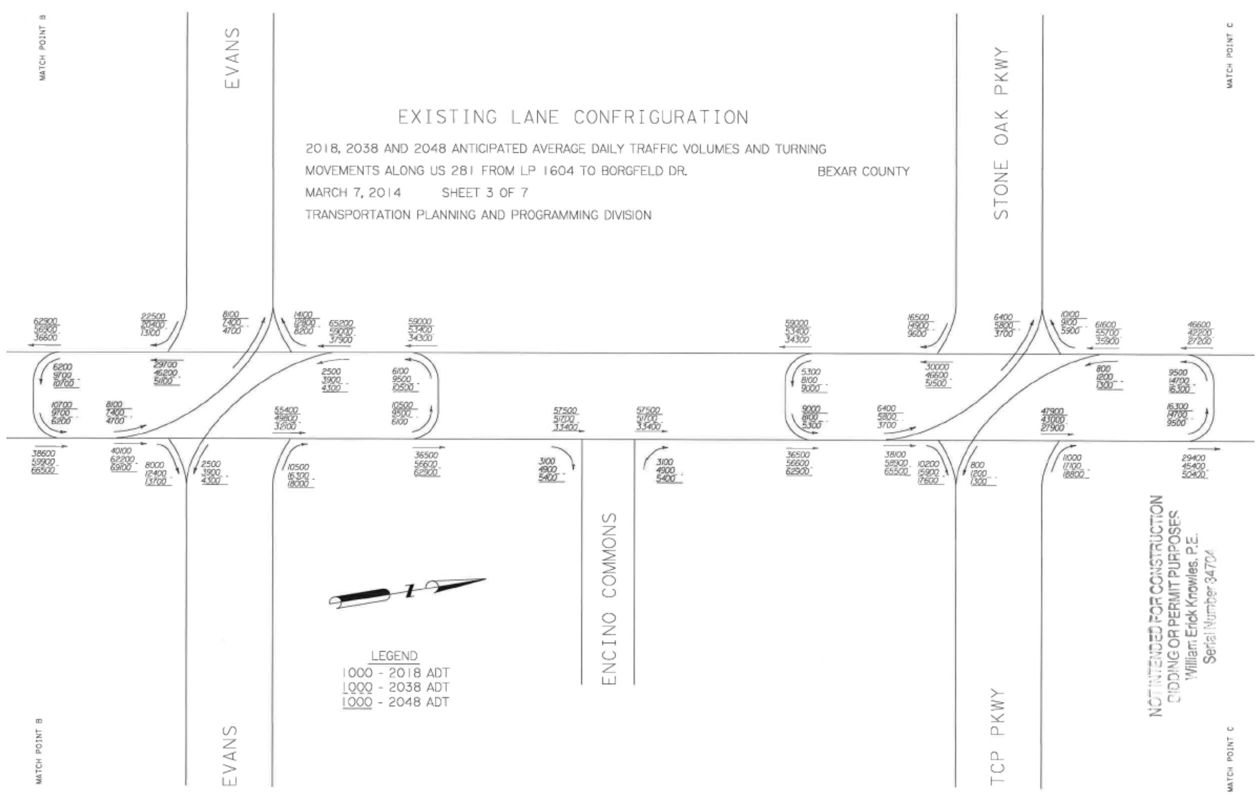
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BEXAR COUNTY
MARCH 7, 2014
SHEET 3 OF 7
TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
ENCINO COMMONS
TCP PKWY
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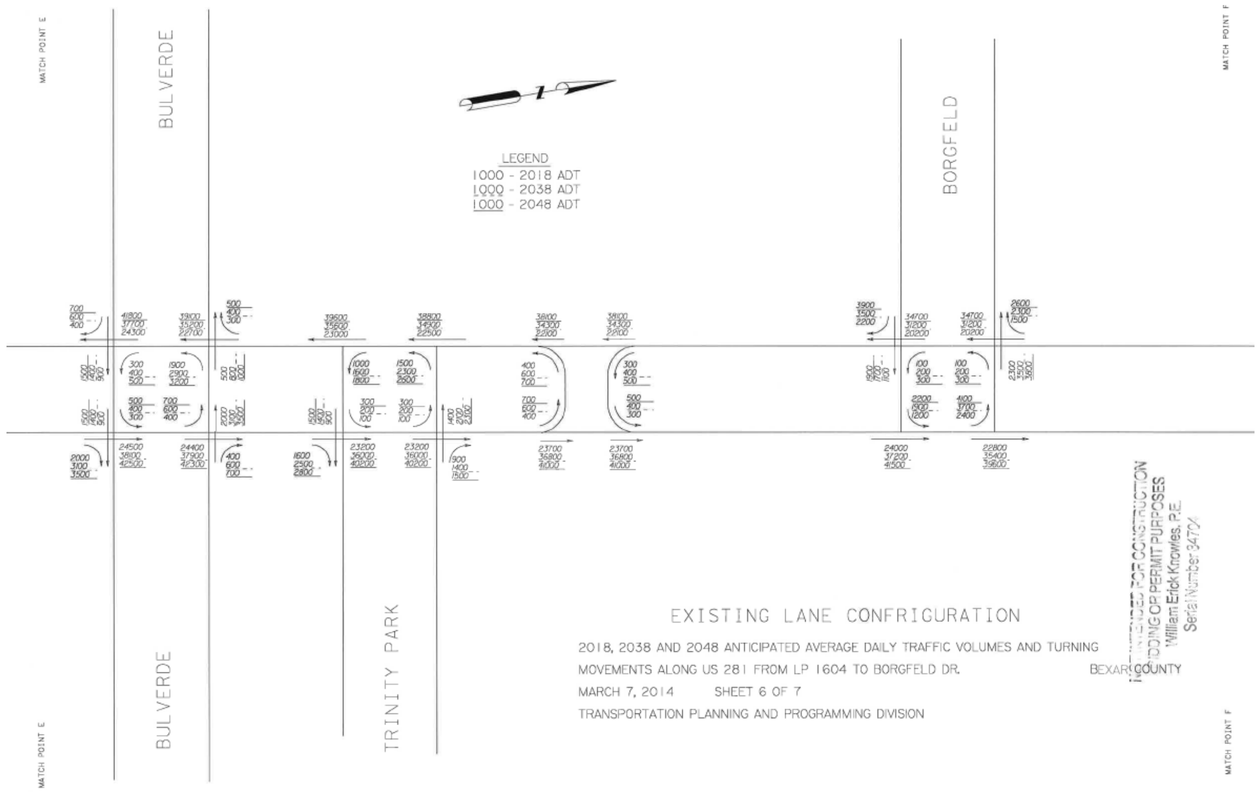
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BORGFELD
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2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING
MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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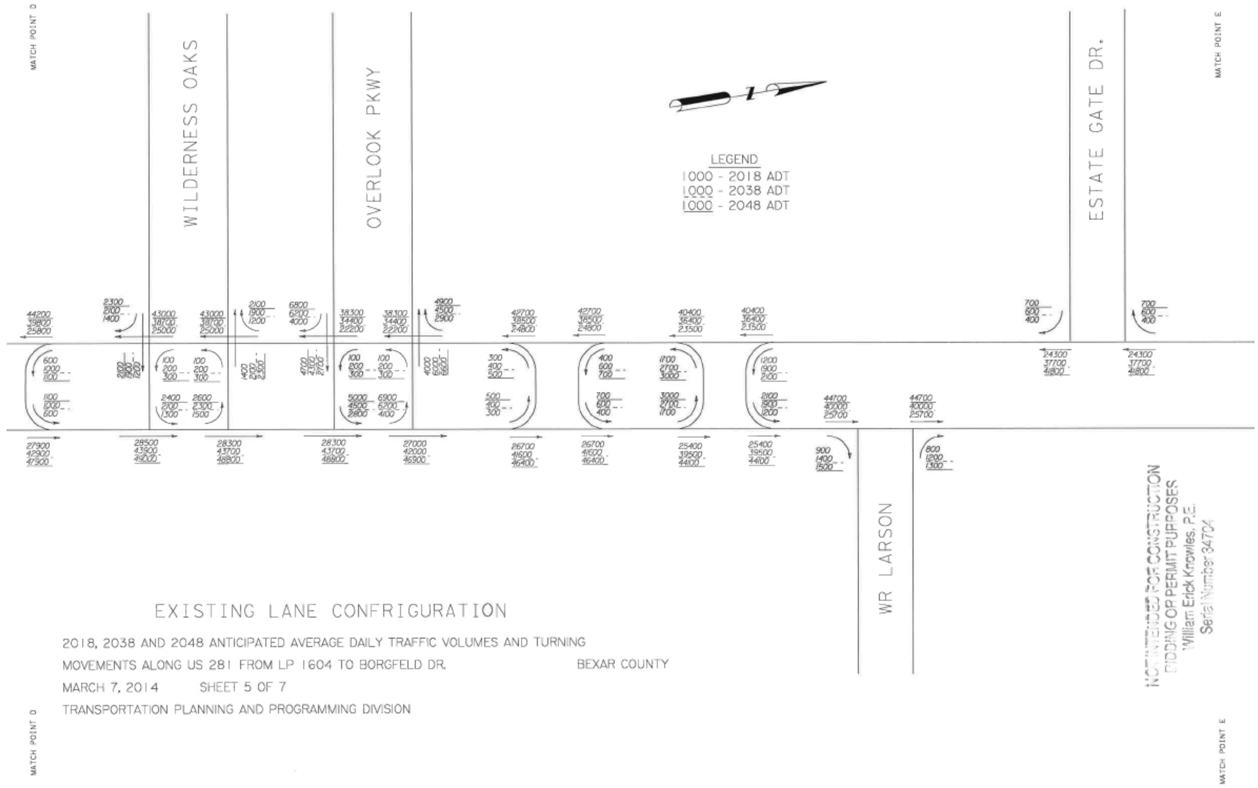
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OVERLOOK PKWY
ESTATE GATE DR.
MATCH POINT E
LEGEND
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WR LARSON
EXISTING LANE CONFRIGURATION
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING
MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES
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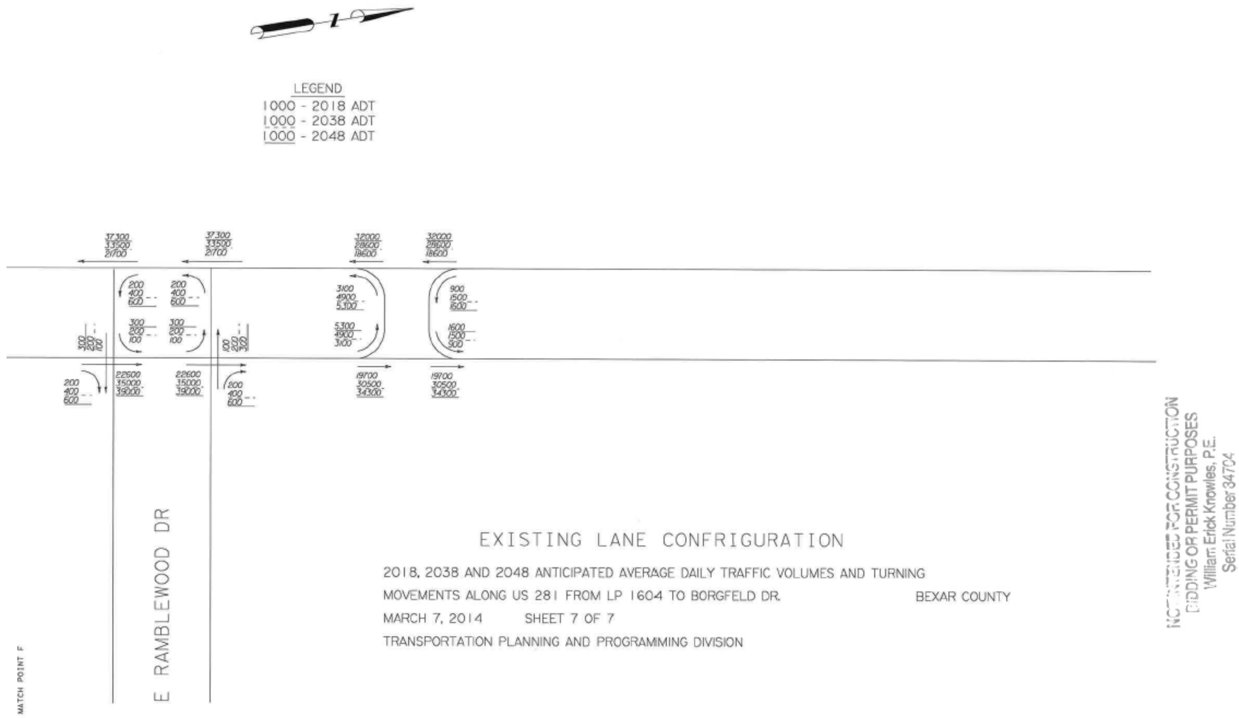
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MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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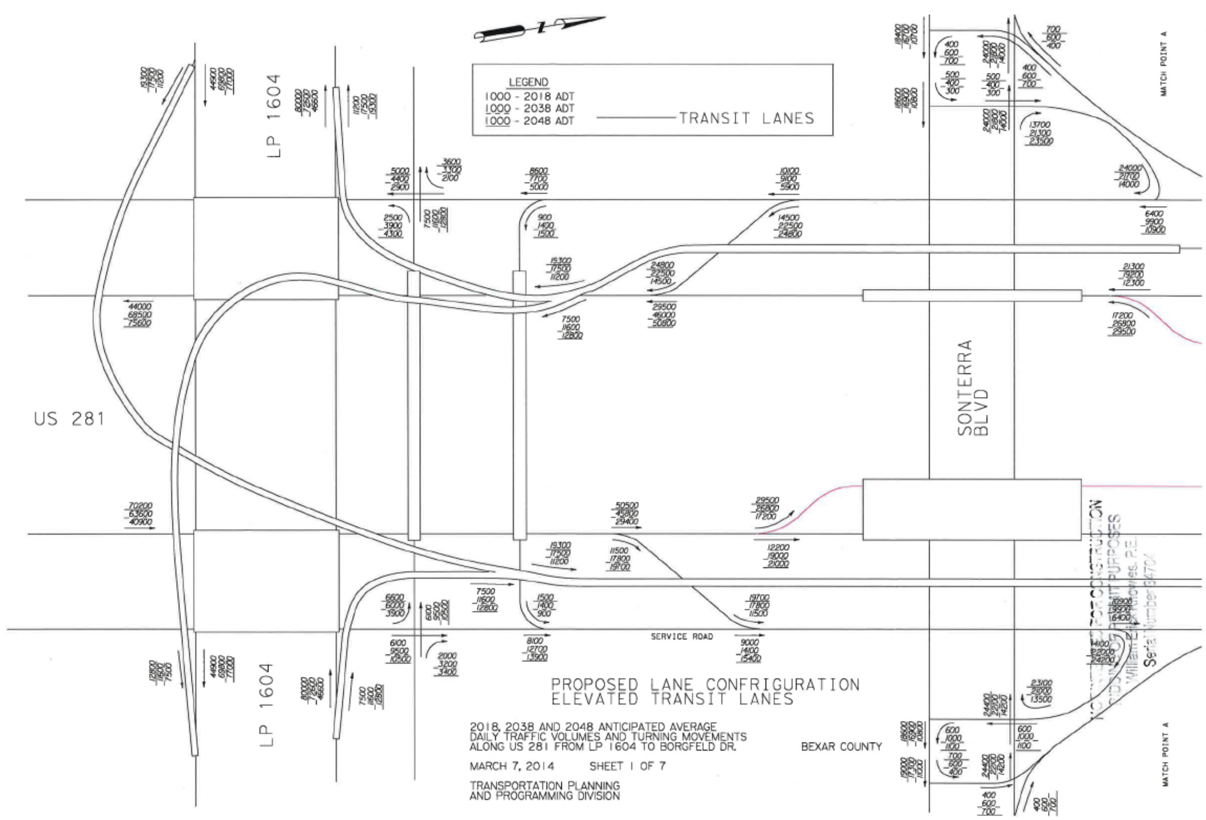
TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 34704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US 281
SONTERRA BLVD
SERVICE ROAD
PROPOSED LANE CONFRIGURATION
ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE
DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS
ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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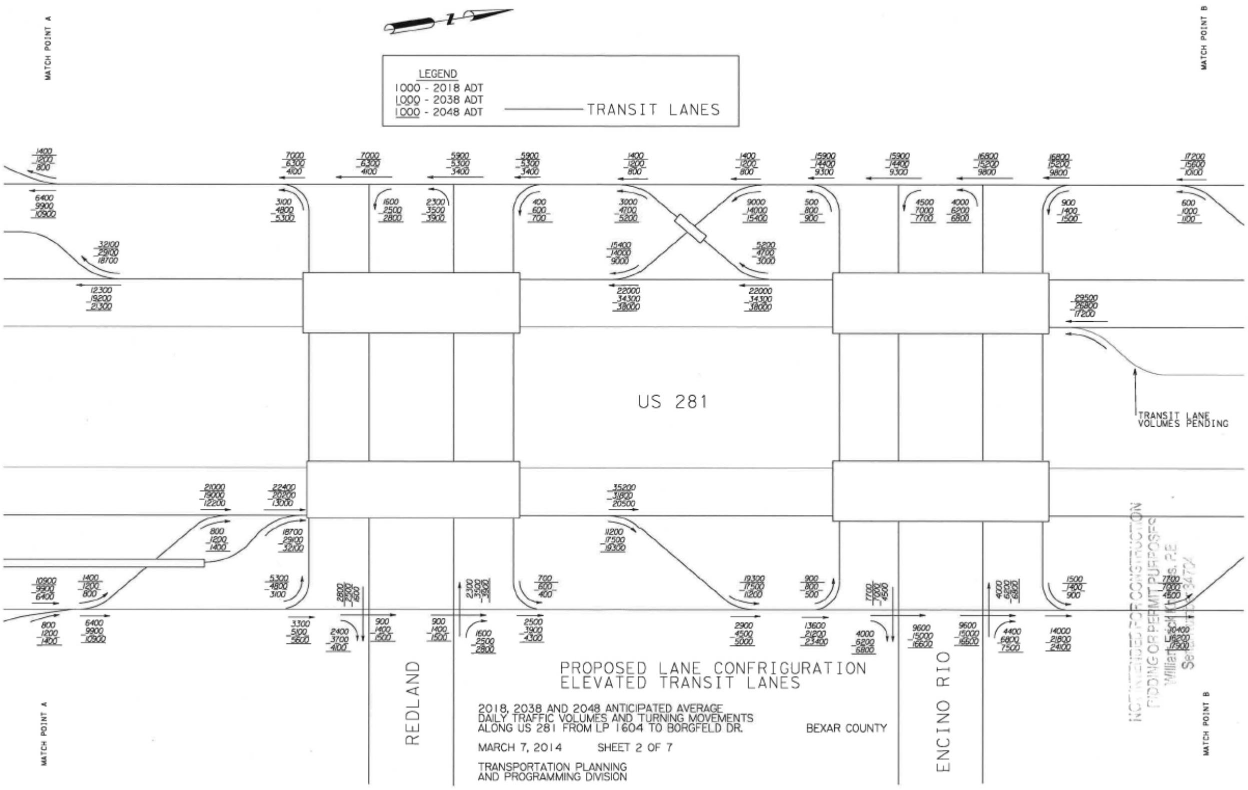
TRANSPORTATION PLANNING
AND PROGRAMMING DIVISION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US 281
TRANSIT LANE VOLUMES PENDING
REDLAND
ENCINO RIO
PROPOSED LANE CONFRIGURATION
ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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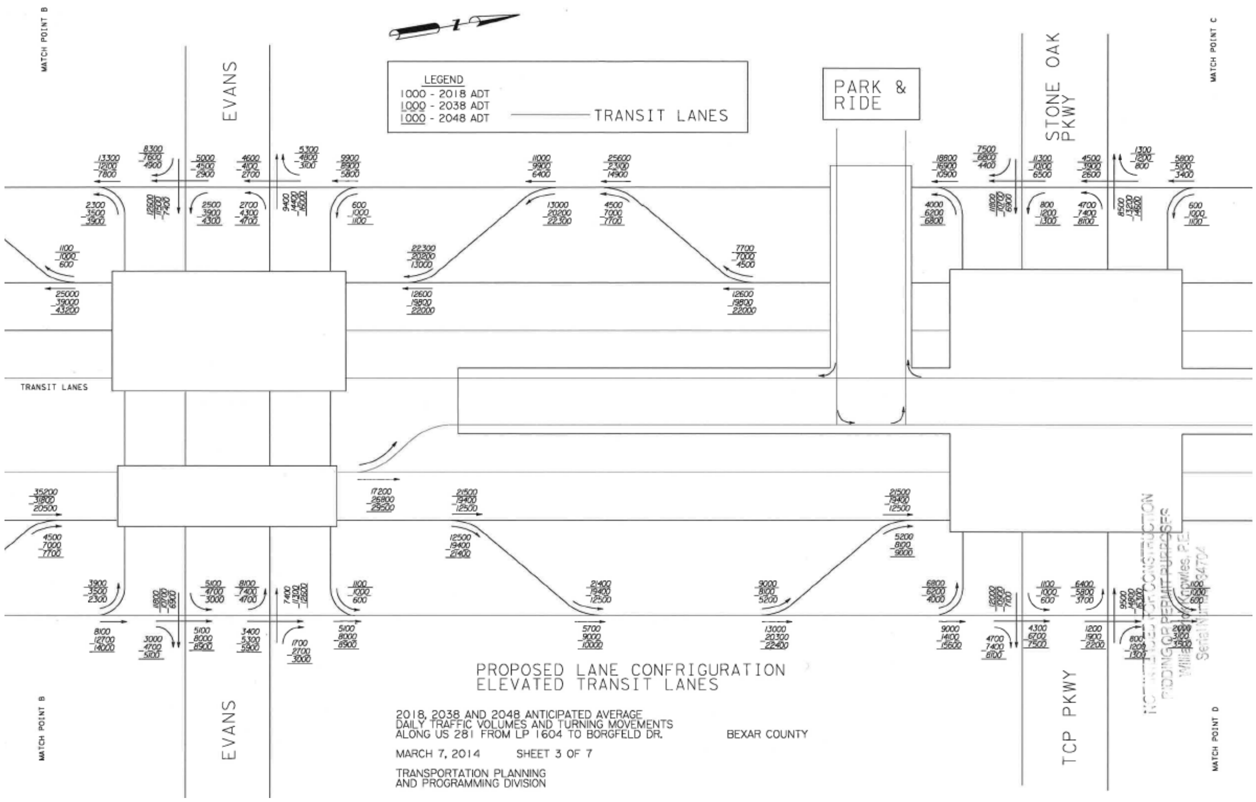
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TRANSIT LANES
EVANS
PARK & RIDE
STONE OAK PKWY
TCP PKWY
PROPOSED LANE CONFRIGURATION
ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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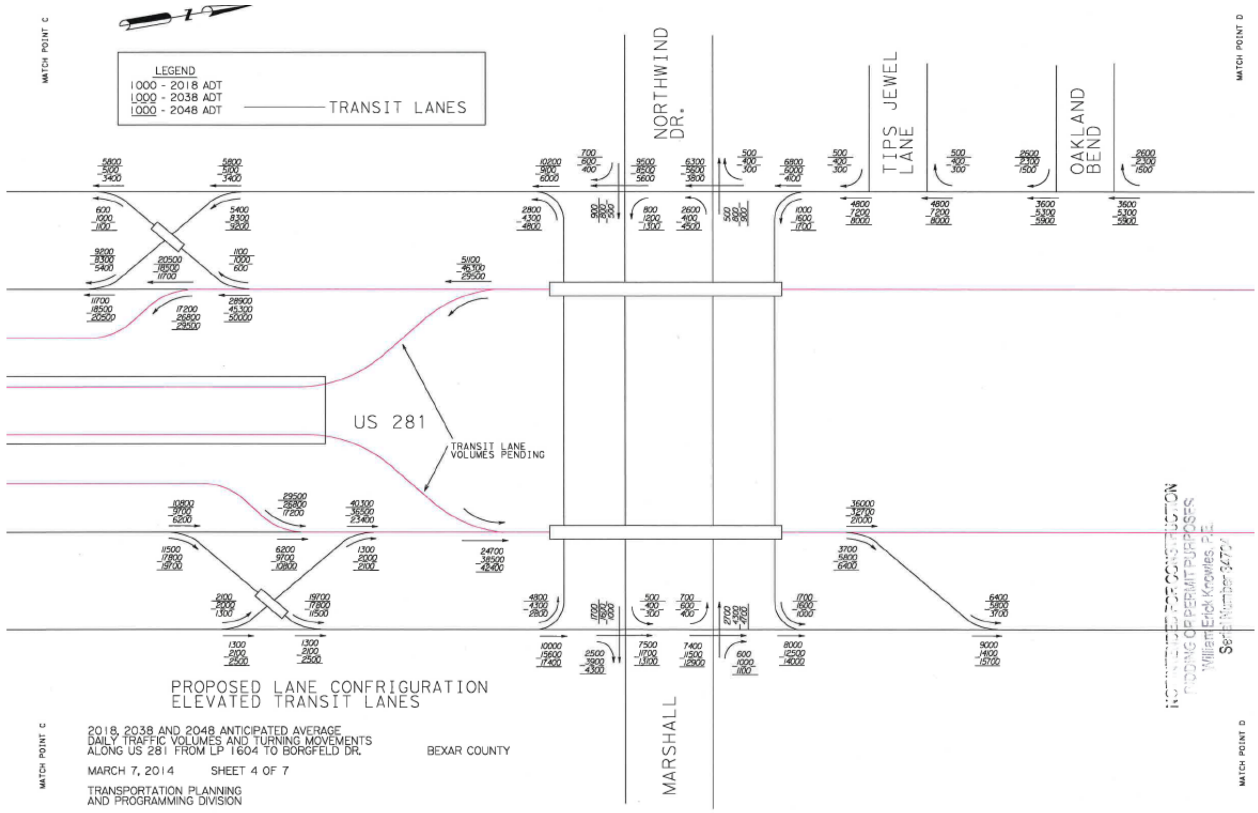
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NORTHWIND DR.
TIPS LANE
JEWEL
OAKLAND BEND
US 281
TRANSIT LANE VOLUMES PENDING
PROPOSED LANE CONFRIGURATION
ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
MARCH 7, 2014
SHEET 4 OF 7
TRANSPORTATION PLANNING AND PROGRAMMING DIVISION
MARSHALL
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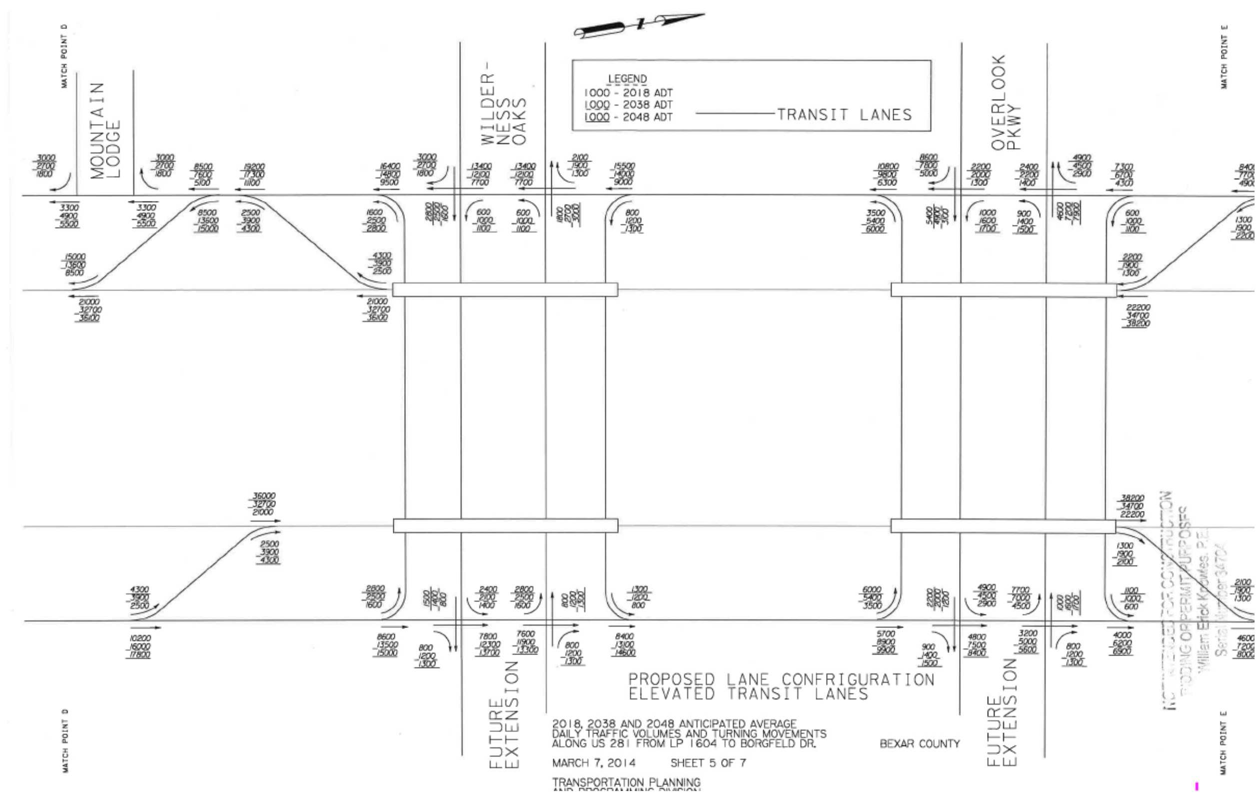
MATCH POINT D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WILDERNESS OAKS
LEGEND
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TRANSIT LANES
OVERLOOK PKWY
FUTURE EXTENSION
PROPOSED LANE CONFRIGURATION
ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
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TRANSPORTATION PLANNING
FUTURE EXTENSION
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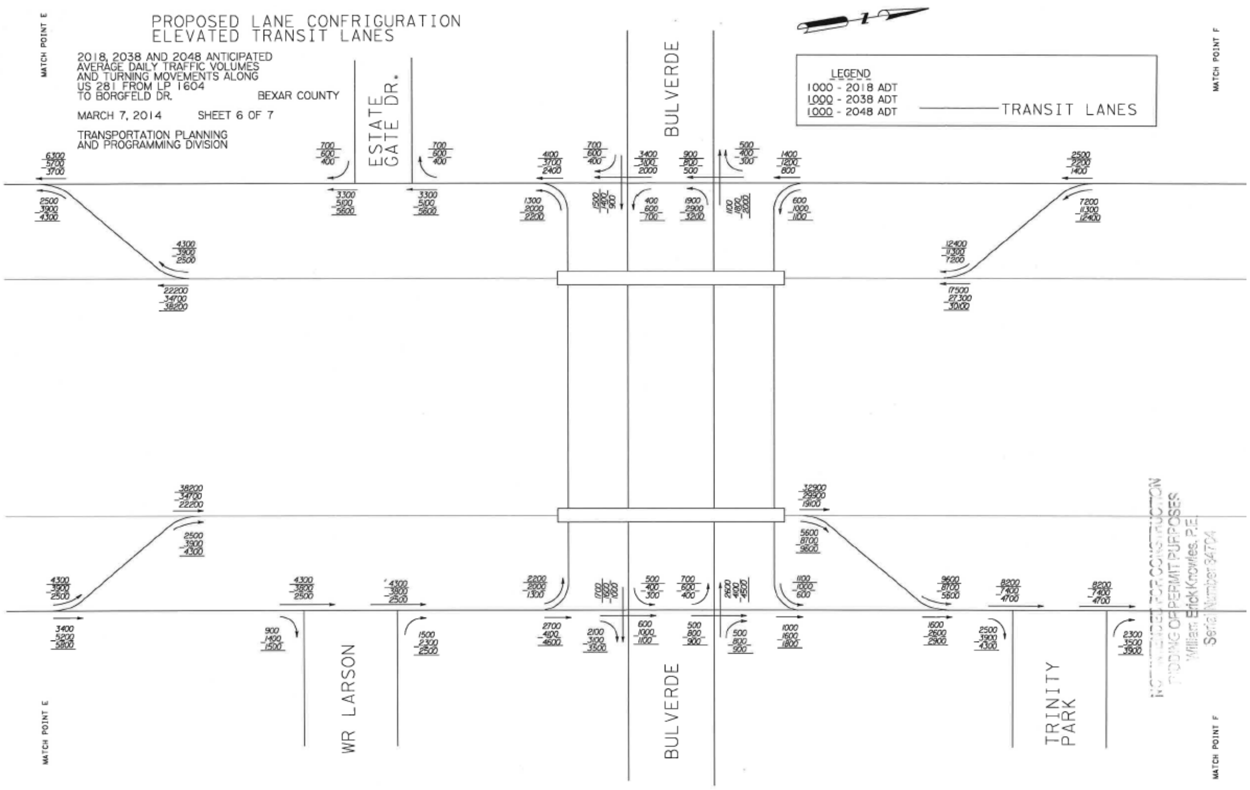
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ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
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ESTATE GATE DR.
BULVERDE
LEGEND
1000 - 2018 ADT
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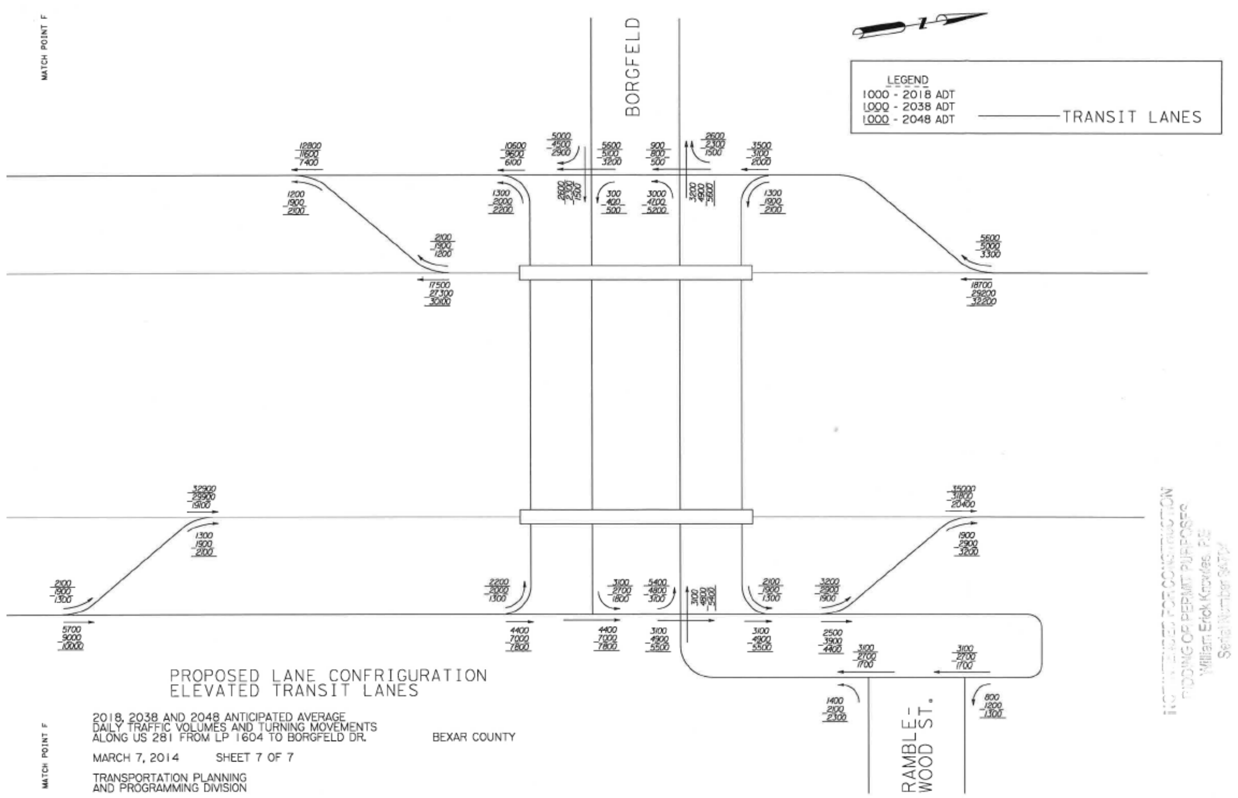
TRANSIT LANES
WR LARSON
TRINITY PARK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ELEVATED TRANSIT LANES
2018, 2038 AND 2048 ANTICIPATED AVERAGE DAILY TRAFFIC VOLUMES AND TURNING MOVEMENTS ALONG US 281 FROM LP 1604 TO BORGFELD DR.
BEXAR COUNTY
MARCH 7, 2014
SHEET 7 OF 7
TRANSPORTATION PLANNING AND PROGRAMMING DIVISION

14 APPENDIX D – VISSM DRIVER BEHAVIOR PARAMETERS MEMORANDUM

JACOBS

Memorandum

Jacobs Engineering Group Inc. Firm # 2966
2705 Bee Cave Road, Suite 300
Austin, Texas, 78746
1.512.314.3100 Fax 1.512.314.3135

Date June 4, 2014

To Jim Robertson, AICP

From James A. Kratz, P.E., PTOE

Subject VISSIM Microscopic Analysis of US 281 between Loop 1604 and Bexar/Comal County Line

Jacobs Engineering Group Inc. was retained by the Alamo Regional Mobility Authority (Alamo RMA) to perform a Final Environmental Impact Statement (FEIS) of the US 281 corridor between Sonterra and the Bexar/Comal County Line. The purpose of this memorandum is to provide results of the traffic operations analyses performed for the preferred alternative along this corridor. This memorandum summarizes the assumptions, methodology and results related to the travel demand modeling, data collection (including travel time runs), development of corridor traffic projections, and traffic operational analysis (using VISSIM).

The full description of the preferred alternative is included in the FEIS, and includes the construction of:

- Three full access-controlled main lanes in each direction between Loop 1604 and Stone Oak Parkway:
  - Two (2) non-tolled general purpose lanes and
  - One (1) managed (tolled) lane; and
- Three full access-controlled managed (tolled) main lanes in each direction between Stone Oak Parkway and the Bexar/Comal County line.

Background

As part of the Draft Environmental Impact Statement (DEIS), Jacobs performed screening analyses of the reasonable alternatives using the San Antonio – Bexar County Metropolitan Planning Organization's (SA-BC MPO) travel demand model. The DEIS alternative screening included a 2035-No Build alternative, 2035-Expressway alternative, and a 2035-Elevated Expressway alternative. Attachment D of the DEIS contained the technical report on the application of the SA-BC MPO travel demand model, and is also included in this Appendix of the FEIS.

For the FEIS, Jacobs was tasked with evaluating the traffic operational analysis of the preferred alternative in the opening year (2018), and the design year (2038). There was no traffic operational evaluation of the existing conditions or the No-Build scenario.

There are three main differences between the DEIS travel demand modeling and the FEIS traffic operational analysis.

- <u>Method of Developing Traffic Projections:</u> Travel demand modeling uses population and employment statistics (organized by market segment) to determine the projected traffic volumes on the regional roadway network using a four-step process (trip generation, trip distribution, modal split, and traffic assignment), and uses traffic counts to validate the current year model volumes. Traffic operational analysis begins with traffic projections developed from historical traffic counts, new traffic counts, and travel demand model runs to define detailed projected traffic volumes using linear growth rates.

- Analysis Capabilities: Travel demand modeling focuses of unconstrained demand over a regional roadway network, with very limited operational analysis capabilities. Traffic operational analysis uses traffic projections specifically developed for a corridor and roadway configuration to determine the capacity, levels of delay and levels of congestion of the roadway elements along the study corridor.
- Purpose of the Traffic Analysis: The travel demand modeling performed for the DEIS was used as a screening tool for the reasonable alternatives, which included a no-build scenario among many other scenarios. The traffic operational analysis in the FEIS considered the preferred alternative only, and focused on determining whether the proposed configuration of the preferred alternative would operate satisfactorily with the projected opening year and design year traffic volumes.

Development of Traffic Projections

The TxDOT Transportation Planning and Programming Division (TPP) developed Year 2018, 2038 and 2048 traffic projections for the US 281 preferred alternative. The Traffic Projections dated March 7, 2014 were received by Jacobs on March 12, 2014. These traffic projections included a K-factor of 8.2%. Using the K-factor, we developed the design hourly volumes (DHV) for both the Opening Year (2018) and Design Year (2038).

In 2038, the traffic projections for the managed lanes between Loop 1604 and Stone Oak Parkway showed 26,800 vehicles per day in each direction. Using the K-factor, the peak DHV for the managed lanes is approximately 2,200 vehicles per hour (vph).

For congested corridors, empirical research on managed lanes has shown that these lanes need to operate between 1400 vph and 1700 vph to provide benefits to the vehicles within the lane. Therefore, the 2038 DHV for the managed lane using the TPP traffic projections was too high.

We performed a sensitivity test on the managed lanes traffic volumes to determine the appropriate volume for the operational analysis. Initially, we redistributed the TPP traffic volumes from the managed lane to the general purpose lanes to achieve 1600 vph within the managed lane. Then, we compared the densities of the general purpose lanes traffic volume that would maintain the desired operational benefit. Finally, we redistributed the TPP traffic volumes from the managed lane to the general purpose lanes to achieve 700 vph in the managed lane.

Operational Analysis Methodology

The daily traffic projections for each element for US 281 were provided by TPP for the years 2018, 2038, and 2048. These projections are in the Attachments to this memorandum. The DHV were developed by using the 8.2% K-factor and are the basis for the traffic operational analyses along the corridor.

The 2010 Edition of the *Highway Capacity Manual (HCM2010)* prescribes procedures to analyze freeway corridors and ancillary facilities, and also defines the Measures of Effectiveness (MOEs) used to analyze traffic operating conditions. However, a shortcoming of *HCM2010* procedures is that it does not fully consider the traffic interaction between different elements of a highway corridor, nor does it fully account for the congestion effect that a segment of highway will have on both the upstream segment and the downstream segment. Therefore, the microscopic simulation tool VISSIM was used to evaluate the US 281 corridor for opening and design year analyses for all of the freeway segments, ramps, frontage roads and intersections. For traffic operation on freeway segments, ramps and frontage road, density and travel time were used as MOEs and for Intersections, total delay was used as the MOE.

Traffic signals were coded in Synchro Professional version 8 (Synchro), a traffic signal operations and optimization tool, to develop appropriate phasing and timing information at each intersection in both the 2018 and 2038 scenarios. These signal phasing and timings were used in the VISSIM models to simulate the traffic operations for these two analysis years.

The level of service (LOS) for the study corridor was then estimated based on *HCM2010* guidelines. LOS is a quantifiable set of operating conditions which describe the relative ease or difficulty for completing a vehicle trip on a particular roadway. The highest LOS "A" is where there is virtually no constraint to the progress of a vehicle trip, where speeds are fairly uniform and high, and the density and total volume of traffic is low. The lowest LOS "F" is characterized by frequent stops and speeds changes with high densities of traffic. The acceptable LOS for the US 281 traffic operation analysis is LOS "D" for the basic freeway segments and LOS "D" for the ramps, weaving areas, frontage roads, and intersections.

There is a small difference to the preliminary design schematic between the opening and the design years. The description of the preferred alternative mentioned above is the design year geometry. The opening year has two full access-controlled managed main lanes in each direction between Marshall Road and the Bexar/Comal County line.

As no plans exist for the future roadway configurations of Marshall Road, Northwind Boulevard, Wilderness Oak Future, and Overlook Parkway Future, we have assumed two through lanes and one right-turn lane approaching the US 281 frontage roads.

VISSIM Analysis

Opening Year (2018) and Design Year (2038) traffic operations along the US 281 corridor between Loop 1604 and the Bexar/Comal County Line was studied using VISSIM microscopic simulation software (version 5.4-12).

VISSIM is a microscopic, time-step and behavior-based simulation software developed to model urban traffic and public transit operations. The program analyzes traffic and transit operations under a series of adjustable parameters such as lane configuration, traffic composition, traffic control devices, and transit stops, among others. For traffic operations, it can provide a diverse array of MOEs such as average total delay, travel times, and densities.

Using the following steps, the VISSIM models were developed to analyze the 2018 and 2038 preliminary design schematic of the study corridor:

- Scaled and imported the AutoCAD drawing of the corridor as the background;

- Developed network geometry (number of lanes, lane widths, acceleration/deceleration lane lengths, lane closures);
- Coded desired speed decisions;
- Coded reduced speed areas where appropriate;
- Coded priority rules where appropriate;
- Coded traffic signal controllers and traffic signal heads;
- Coded traffic signal timings, optimized using Synchro to accommodate 2018 and 2038 volumes (created *.rbc signal controller files);
- Coded input volumes and routing decisions; and
- Coded travel time segments (one in the northbound direction from Loop 1604 to the Bexar / Comal County line and the other in the southbound direction from the Bexar / Comal County line to Loop 1604).

In order to ensure an accurate replication of the congestion occurring during the peak hour, a 15 min pre-load period is included as a standard practice in microscopic simulation, and is recommended and preferred by Federal Highway Administration (FHWA).

It should be noted that, both VISSIM models (2018 and 2038) were run for ten (10) simulation runs with different seed numbers. The MOEs were extracted from the multiple simulation runs and their results averaged before comparing with the input volumes, thus minimizing the chance of outliers yielded by the stochastic element of the software. Furthermore, to prevent the bias caused by an initially empty network, MOEs were collected only after the simulation had run for 15 minutes (0-900 seconds of warm up time). MOEs were then collected for the design one-hour peak period (i.e. 60 minutes between 900 – 4500 seconds).

Both VISSIM models (2018 and 2038) used the car following and lane-changing parameters that are included in the Attachments to this memorandum.

2018 Design Schematic Analysis

During the 2018 Design Peak Hour, the results of the VISSIM analysis show decent speeds in the study corridor both in the northbound and southbound directions, with the proposed improvements in place. Similarly, densities and LOS along the study corridor were shown to be at acceptable levels. The entire study corridor was found to operate at LOS “B” or better, except (1) the freeway segment in the southbound direction between the Encino entrance ramp and the exit ramp to the Loop 1604 Direct Connect ramps (DCs) and (2) the southbound entrance ramp from Sonterra Boulevard, both of which operate at LOS “C.” Table 1 and Table 2 show the density and LOS for all of freeway segments and ramps in the study corridor. Speed, density, and link LOS line diagrams are provided in the Attachments to this memorandum.

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Memorandum

(Continued)

Table 1

Freeway Segments - 2018 Density & LOS						
Direction	Link No.	Segment From	Segment To	Segment Type	Density/Lane (pc/mi/ln)	LOS
SB	41	North End of Study Area	Borgfeld Exit Ramp	Basic Freeway	13.8	B
	44	Borgfeld Exit Ramp	Bulverde Exit Ramp	Basic Freeway	11.4	B
	45	Bulverde Exit Ramp	Borgfeld Entrance Ramp	Basic Freeway	10.8	A
	47	Borgfeld Entrance Ramp	Overlook Exit Ramp	Weaving	10.3	A
	49	Overlook Exit Ramp	Bulverde Entrance Ramp	Basic Freeway	13.7	B
	106	Bulverde Entrance Ramp	Marshall Exit Ramp	Basic Freeway	14.6	B
	51	Marshall Exit Ramp	Wilderness Entrance Ramp	Basic Freeway	13.1	B
	54	Wilderness Entrance Ramp	Stone Oak Exit Ramp	Weaving	9.3	A
	55	Stone Oak Exit Ramp	Marshall Entrance Ramp	Basic Freeway	12.1	B
	59	Marshall Entrance Ramp	Evans Exit Ramp	Weaving	8.4	A
	125	Evans Exit Ramp	Stone Oak Entrance Ramp	Basic Freeway	15.5	B
	65	Stone Oak Entrance Ramp	Encino Exit Ramp	Weaving	15.9	B
	67	Encino Exit Ramp	Redland Exit Ramp	Basic Freeway	15.5	B
	183	Redland Exit Ramp	Encino Entrance Ramp	Basic Freeway	14.3	B
	192	Encino Entrance Ramp	DCs to Loop 1604	Basic Freeway	19.0	C
	70	DCs to Loop 1604	Managed Lane Exit Ramp	Basic Freeway	15.4	B
	71	Managed Lane Exit Ramp	Sonterra Entrance Ramp	Basic Freeway	12.5	B
	260	Sonterra Entrance Ramp	South End of Study Area	Basic Freeway	13.8	B
NB	1	South End of Study Area	Sonterra Exit Ramp	Basic Freeway	16.9	B
	43	Sonterra Exit Ramp	Loop 1604 FR Entrance Ramp	Basic Freeway	12.0	B
	7	Loop 1604 FR Entrance Ramp	DCs from Loop 1604	Basic Freeway	15.5	B
	8	DCs from Loop 1604	Encino Rio Exit Ramp	Weaving	13.3	B
	9	Encino Rio Exit Ramp	Encino Entrance Ramp	Basic Freeway	13.2	B
	12	Encino Entrance Ramp	Stone Oak Exit Ramp	Weaving	11.3	B
	16	Stone Oak Exit Ramp	Evans Entrance Ramp	Basic Freeway	15.1	B
	19	Evans Entrance Ramp	Marshall Exit Ramp	Weaving	11.7	B
	23	Marshall Exit Ramp	Stone Oak Entrance Ramp	Basic Freeway	9.2	A
	24	Stone Oak Entrance Ramp	Managed Lane Egress	Weaving	7.0	A
	253	Managed Lane Egress	Wilderness Exit Ramp	Weaving	7.5	A
	299	Wilderness Exit Ramp	Marshall Entrance Ramp	Basic Freeway	12.7	B
	30	Marshall Entrance Ramp	Bulverde Exit Ramp	Basic Freeway	14.3	B
	33	Bulverde Exit Ramp	Overlook Entrance Ramp	Basic Freeway	13.5	B
	135	Overlook Entrance Ramp	Borgfeld Exit Ramp	Weaving	10.1	A
	34	Borgfeld Exit Ramp	Bulverde Entrance Ramp	Basic Freeway	11.6	B
	37	Bulverde Entrance Ramp	Borgfeld Entrance Ramp	Basic Freeway	12.4	B
	42	Borgfeld Entrance Ramp	North End of Study Area	Basic Freeway	13.5	B

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Memorandum
(Continued)

Table 2

Direction	Link No.	Segment	Density/Lane (pc/mi/ln)	LOS
SB	137	Exit Ramp to Borgfeld	2.3	A
	46	Exit Ramp to Bulverde	1.9	A
	48	Entrance Ramp from Borgfeld	10.3	B
	50	Exit Ramp to Overlook	4.0	A
	136	Entrance Ramp from Bulverde	2.2	A
	52	Exit Ramp to Marshall	3.7	A
	53	Entrance Ramp from Wilderness	12.9	B
	56	Exit Ramp to Stone Oak	1.0	A
	57	Entrance Ramp from Marshall	3.9	A
	60	Park & Ride Exit Ramp	0.7	A
	62	Exit Ramp to Evans	6.8	A
	63	Exit Ramp to Managed Lanes	5.5	A
	66	Entrance Ramp from Stone Oak	19.7	B
	68	Exit Ramp to Encino	0.9	A
	196	Exit Ramp to Redland	5.0	A
	197	Entrance Ramp from Encino	15.6	B
	72	Exit Ramp to Loop 1604 DCs	16.2	B
	69	Entrance Ramp from Managed Lanes	6.3	A
	201	Entrance Ramp from Sonterra	21.5	C
NB	200	Exit Ramp to Sonterra	16.7	B
	3	Entrance Ramp Loop 1604 FR	1.2	A
	10	Exit Ramp to Managed Lanes	6.4	A
	262	Entrance Ramp from Loop 1604 DCs	16.5	B
	11	Exit Ramp to Encino	8.3	A
	13	Entrance Ramp from Encino	6.4	A
	14	Exit Ramp to Stone Oak	18.2	B
	20	Entrance Ramp to Evans	7.6	A
	22	Exit Ramp to Marshall	9.0	A
	17	Entrance Ramp from Managed Lanes	5.7	A
	26	Entrance Ramp from Park & Ride	0.7	A
	25	Entrance Ramp from Stone Oak	1.8	A
	29	Exit Ramp to Wilderness	5.4	A
	31	Entrance Ramp from Marshall	3.6	A
	111	Exit Ramp to Bulverde	1.8	A
	32	Entrance Ramp from Overlook	3.6	A
	35	Exit Ramp to Borgfeld	8.2	A
	38	Entrance Ramp from Bulverde	1.8	A
	40	Entrance Ramp from Borgfeld	1.4	A

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Memorandum

(Continued)

Output (processed) volumes were collected in VISSIM for the design peak hour to ensure that the input (demand) volume on the proposed roadway network enters the system and is used by VISSIM. The VISSIM model was able to process 99% of the demand volume in the study corridor. Line diagrams showing the processed volumes and tables showing the volume comparisons are found in the Attachments to this memorandum.

In addition to the analysis of the main lanes, intersection analysis of the proposed cross streets was also performed for the preferred schematic. The results from the VISSIM analysis show that all of the cross street intersections and approaches are anticipated to operate at a LOS "C" or better with the proposed improvements in place, except some of the approaches at the intersections of Marshall Road and Stone Oak Parkway with the frontage roads, which are anticipated to operate at LOS "D". Table 3 shows the approach control delay, intersection control delay, approach LOS and intersection LOS. Approach / Intersection Control Delay and LOS line diagrams are provided in the Attachments to this memorandum.

Table 3

2018 Delay & LOS (Approach/ Intersection)

Intersection	Approach	Average Delay (sec)	Approach Level of Service	Overall Delay (sec)	Overall Level of Service
Redland & NB FR	Southbound	-	-	8.64	A
	Westbound	14.2	B		
	Northbound	5.9	A		
	Eastbound	5.8	A		
Redland & SB FR	Southbound	19.4	B	11.92	B
	Westbound	4.5	A		
	Northbound	-	-		
	Eastbound	-	-		
Encino & NB FR	Southbound	-	-	16.27	B
	Westbound	23.6	C		
	Northbound	24.9	C		
	Eastbound	0.3	A		
Encino & SB FR	Southbound	26.6	C	13.79	B
	Westbound	1.0	A		
	Northbound	-	-		
	Eastbound	-	-		
Evans & NB FR	Southbound	-	-	22.99	C
	Westbound	34.7	C		
	Northbound	33.0	C		
	Eastbound	1.3	A		
Evans & SB FR	Southbound	19.8	B	17.52	B
	Westbound	1.2	A		
	Northbound	-	-		
	Eastbound	31.6	C		
Stone Oak & NB FR	Southbound	-	-	22.29	C
	Westbound	44.8	D		
	Northbound	21.1	C		
	Eastbound	0.9	A		

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(Continued)

Intersection	Approach	Average Delay (sec)	Approach Level of Service	Overall Delay (sec)	Overall Level of Service
Stone Oak & SB FR	Southbound	44.3	D	30.46	C
	Westbound	2.1	A		
	Northbound	-	-		
	Eastbound	44.9	D		
Marshall & NB FR	Southbound	-	-	21.99	C
	Westbound	41.4	D		
	Northbound	22.5	C		
	Eastbound	2.0	A		
Marshall & SB FR	Southbound	49.1	D	28.26	C
	Westbound	8.6	A		
	Northbound	-	-		
	Eastbound	27.1	C		
Wilderness & NB FR	Southbound	-	-	22.49	C
	Westbound	34.2	C		
	Northbound	32.6	C		
	Eastbound	0.7	A		
Wilderness & SB FR	Southbound	29.6	C	20.18	C
	Westbound	0.3	A		
	Northbound	-	-		
	Eastbound	30.6	C		
Overlook & NB FR	Southbound	-	-	17.57	B
	Westbound	25.2	C		
	Northbound	25.9	C		
	Eastbound	1.7	A		
Overlook & SB FR	Southbound	14.2	B	11.28	B
	Westbound	1.3	A		
	Northbound	-	-		
	Eastbound	18.4	B		
Bulverde & NB FR	Southbound	-	-	12.11	B
	Westbound	22.4	C		
	Northbound	6.7	A		
	Eastbound	7.2	A		
Bulverde & SB FR	Southbound	22.5	C	14.67	B
	Westbound	4.1	A		
	Northbound	-	-		
	Eastbound	17.4	B		
Borgfeld & NB FR	Southbound	-	-	19.80	B
	Westbound	32.4	C		
	Northbound	25.1	C		
	Eastbound	1.9	A		
Borgfeld & SB FR	Southbound	12.5	B	10.14	B
	Westbound	4.7	A		
	Northbound	-	-		
	Eastbound	13.2	B		

2038 Design Schematic Analysis
During the 2038 Design Peak Hour, the results of the VISSIM analysis show decent speeds in the study corridor both in the northbound and southbound directions. Similarly, densities and LOS along the study corridor are at acceptable levels. The northbound roadway segments are anticipated to operate at LOS "C" or better throughout the study corridor, with the proposed improvements in place, except (1) the freeway segment in the southbound direction between the entrance ramp from Encino Drive and the exit ramp to the Loop 1604 DCs, and (2) upstream of the Sonterra Boulevard exit ramp. The northbound direction, SB On-ramp from Stone Oak, and NB Off-ramp to Stone Oak operate at LOS "D". Table 4 and Table 5 shows the Density and LOS for all of the freeway segments and ramps in the study corridor. Speed, density, and link LOS line diagrams are provided in the Attachments to this memorandum.

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(Continued)

Table 4

Freeway Segments - 2038 Density & LOS						
Direction	Link No.	Segment From	Segment To	Segment Type	Density/Lane (pc/mi/ln)	LOS
SB	41	North End of Study Area	Borgfeld Exit Ramp	Basic Freeway	21.8	C
	44	Borgfeld Exit Ramp	Bulverde Exit Ramp	Basic Freeway	11.8	B
	45	Bulverde Exit Ramp	Borgfeld Entrance Ramp	Basic Freeway	11.2	B
	47	Borgfeld Entrance Ramp	Overlook Exit Ramp	Weaving	16.3	B
	49	Overlook Exit Ramp	Bulverde Entrance Ramp	Basic Freeway	14.3	B
	106	Bulverde Entrance Ramp	Marshall Exit Ramp	Basic Freeway	15.0	B
	51	Marshall Exit Ramp	Wilderness Entrance Ramp	Basic Freeway	13.5	B
	54	Wilderness Entrance Ramp	Stone Oak Exit Ramp	Weaving	14.6	B
	55	Stone Oak Exit Ramp	Marshall Entrance Ramp	Basic Freeway	19.0	C
	59	Marshall Entrance Ramp	Evans Exit Ramp	Weaving	13.1	B
	125	Evans Exit Ramp	Stone Oak Entrance Ramp	Basic Freeway	24.3	C
	65	Stone Oak Entrance Ramp	Encino Exit Ramp	Weaving	24.5	C
	67	Encino Exit Ramp	Redland Exit Ramp	Basic Freeway	23.6	C
	183	Redland Exit Ramp	Encino Entrance Ramp	Basic Freeway	21.8	C
	192	Encino Entrance Ramp	DCs to Loop 1604	Basic Freeway	32.5	D
	70	DCs to Loop 1604	Managed Lane Exit Ramp	Basic Freeway	23.8	C
	71	Managed Lane Exit Ramp	Sonterra Entrance Ramp	Basic Freeway	18.8	C
	260	Sonterra Entrance Ramp	South End of Study Area	Basic Freeway	19.6	C
NB	1	South End of Study Area	Sonterra Exit Ramp	Basic Freeway	27.0	D
	43	Sonterra Exit Ramp	Loop 1604 FR Entrance Ramp	Basic Freeway	19.2	C
	7	Loop 1604 FR Entrance Ramp	DC's from Loop 1604	Basic Freeway	24.8	C
	8	DC's from Loop 1604	Encino Rio Exit Ramp	Weaving	21.0	C
	9	Encino Rio Exit Ramp	Encino Entrance Ramp	Basic Freeway	20.9	C
	12	Encino Entrance Ramp	Stone Oak Exit Ramp	Weaving	17.9	B
	16	Stone Oak Exit Ramp	Evans Entrance Ramp	Basic Freeway	24.7	C
	19	Evans Entrance Ramp	Marshall Exit Ramp	Weaving	18.8	C
	23	Marshall Exit Ramp	Stone Oak Entrance Ramp	Basic Freeway	14.7	B
	24	Stone Oak Entrance Ramp	Managed Lane Egress	Weaving	11.3	B
	253	Managed Lane Egress	Wilderness Exit Ramp	Weaving	12.0	B
	28	Wilderness Exit Ramp	Marshall Entrance Ramp	Basic Freeway	13.6	B
	30	Marshall Entrance Ramp	Bulverde Exit Ramp	Basic Freeway	15.1	B
	33	Bulverde Exit Ramp	Overlook Entrance Ramp	Basic Freeway	14.4	B
	135	Overlook Entrance Ramp	Borgfeld Exit Ramp	Weaving	12.2	B
	34	Borgfeld Exit Ramp	Bulverde Entrance Ramp	Basic Freeway	12.4	B
	37	Bulverde Entrance Ramp	Borgfeld Entrance Ramp	Basic Freeway	20.1	C
	42	Borgfeld Entrance Ramp	North End of Study Area	Basic Freeway	22.2	C

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(Continued)

Table 5

Ramp Segments - 2038 Density & LOS

Direction	Link No.	Segment	Density/Lane (pc/mi/ln)	LOS
SB	137	Exit Ramp to Borgfeld	3.5	A
	46	Exit Ramp to Bulverde	2.9	A
	48	Entrance Ramp from Borgfeld	16.0	B
	50	Exit Ramp to Overlook	6.1	A
	136	Entrance Ramp from Bulverde	2.8	A
	52	Exit Ramp to Marshall	5.5	A
	53	Entrance Ramp from Wilderness	20.9	C
	56	Exit Ramp to Stone Oak	1.8	A
	57	Entrance Ramp from Marshall	6.1	A
	60	Park & Ride Exit Ramp	1.5	A
	62	Exit Ramp to Evans	10.7	B
	63	Exit Ramp to Managed Lanes	8.8	A
	66	Entrance Ramp from Stone Oak	30.3	D
	68	Exit Ramp to Encino	1.6	A
	196	Exit Ramp to Redland	7.8	A
	197	Entrance Ramp from Encino	23.1	C
	72	Exit Ramp to Loop 1604 DCs	24.9	C
	69	Entrance Ramp from Managed Lanes	10.4	B
	201	Entrance Ramp from Sonterra	27.0	C
NB	200	Exit Ramp to Sonterra	25.9	C
	3	Entrance Ramp Loop 1604 FR	1.9	A
	10	Exit Ramp to Managed Lanes	9.7	A
	262	Entrance Ramp from Loop 1604 DCs	26.2	C
	11	Exit Ramp to Encino	12.9	B
	13	Entrance Ramp from Encino	10.3	B
	14	Exit Ramp to Stone Oak	28.9	D
	20	Entrance Ramp to Evans	12.3	B
	22	Exit Ramp to Marshall	14.2	B
	17	Entrance Ramp from Managed Lanes	9.3	A
	26	Entrance Ramp from Park & Ride	1.5	A
	25	Entrance Ramp from Stone Oak	3.0	A
	29	Exit Ramp to Wilderness	8.5	A
	31	Entrance Ramp from Marshall	5.6	A
	111	Exit Ramp to Bulverde	2.6	A
	32	Entrance Ramp from Overlook	5.7	A
	35	Exit Ramp to Borgfeld	13.4	B
	38	Entrance Ramp from Bulverde	2.8	A
	40	Entrance Ramp from Borgfeld	2.7	A

Output (processed) volumes were collected in VISSIM for the design peak hour to ensure that the input (demand) volume on the proposed roadway network enters the system and is used by VISSIM. The VISSIM model was able to process 99% of the demand volume in the study corridor. Line diagrams showing the processed volumes and tables showing the volume comparisons are found in the Attachments to this memorandum.

In addition to the analysis of the main lanes, intersection analyses were performed for the proposed cross street intersections for the 2038 Design Peak Hour Volumes. The results from the VISSIM analysis shows that all of the cross street intersections and approaches are anticipated to operate at LOS "D" or better with the proposed improvements in place, except some of the approaches at the intersections of Stone Oak Boulevard and Marshall Road with the northbound and southbound frontage roads, which are anticipated to operate at LOS "E" and LOS "F." Table 6 shows the approach control delay, intersection control delay, approach LOS and intersection LOS. Line diagrams of the approach and intersection control delay and LOS are provided in Attachments to this memorandum.

Table 6

2038 Delay & LOS

Intersection	Approach	Average Delay (sec)	Approach Level of Service	Overall Delay (sec)	Overall Level of Service
Redland & NB FR	Southbound	-	-	8.93	A
	Westbound	14.0	B		
	Northbound	6.9	A		
	Eastbound	5.9	A		
Redland & SB FR	Southbound	22.1	C	12.81	B
	Westbound	3.6	A		
	Northbound	-	-		
	Eastbound	-	-		
Encino & NB FR	Southbound	-	-	18.97	B
	Westbound	25.9	C		
	Northbound	30.6	C		
	Eastbound	0.4	A		
Encino & SB FR	Southbound	31.7	C	16.44	B
	Westbound	1.2	A		
	Northbound	-	-		
	Eastbound	-	-		
Evans & NB FR	Southbound	-	-	33.15	C
	Westbound	48.7	D		
	Northbound	49.4	D		
	Eastbound	1.4	A		
Evans & SB FR	Southbound	26.3	C	22.01	C
	Westbound	1.9	A		
	Northbound	-	-		
	Eastbound	37.8	D		
Stone Oak & NB FR	Southbound	-	-	35.52	D
	Westbound	79.5	E		
	Northbound	25.8	C		
	Eastbound	1.3	A		

Intersection	Approach	Average Delay (sec)	Approach Level of Service	Overall Delay (sec)	Overall Level of Service
Stone Oak & SB FR	Southbound	48.4	D	97.06	F
	Westbound	4.8	A		
	Northbound	-	-		
	Eastbound	237.9	F		
Marshall & NB FR	Southbound	-	-	33.77	C
	Westbound	73.4	E		
	Northbound	26.6	C		
	Eastbound	1.4	A		
Marshall & SB FR	Southbound	52.0	D	32.72	C
	Westbound	16.8	B		
	Northbound	-	-		
	Eastbound	29.3	C		
Wilderness & NB FR	Southbound	-	-	25.12	C
	Westbound	35.3	D		
	Northbound	39.3	D		
	Eastbound	0.8	A		
Wilderness & SB FR	Southbound	33.6	C	23.38	C
	Westbound	0.5	A		
	Northbound	-	-		
	Eastbound	36.0	D		
Overlook & NB FR	Southbound	-	-	22.22	C
	Westbound	29.5	C		
	Northbound	35.2	D		
	Eastbound	2.0	A		
Overlook & SB FR	Southbound	17.7	B	13.33	B
	Westbound	1.6	A		
	Northbound	-	-		
	Eastbound	20.7	C		
Bulverde & NB FR	Southbound	-	-	12.59	B
	Westbound	24.0	C		
	Northbound	7.6	A		
	Eastbound	6.1	A		
Bulverde & SB FR	Southbound	22.9	C	16.25	B
	Westbound	6.7	A		
	Northbound	-	-		
	Eastbound	19.2	B		
Borgfeld & NB FR	Southbound	-	-	26.13	C
	Westbound	48.4	D		
	Northbound	28.0	C		
	Eastbound	2.1	A		
Borgfeld & SB FR	Southbound	13.7	B	11.97	B
	Westbound	8.8	A		
	Northbound	-	-		
	Eastbound	13.3	B		

Travel Time Studies

Travel Time Studies were completed on May 7, 2014 for the US 281 Corridor. Two drivers made three runs each during the morning and evening rush hours using GPS-based travel time tablets. During the evening rush hour travel time study, traffic headed northbound into the study corridor was impeded by an accident near Bitters Road (3 miles south of the study corridor) which had traffic in two of the three lanes blocked. Also, this is the same night as one of the Spurs playoff games, which may have diverted some traffic away from a normal commute home. As a result, traffic congestion north of Loop 1604 was potentially less than a normal day. Travel times for the northbound direction would have likely increased if not for these events.

We compared true travel times versus those predicted by the 2018 and 2038 VISSIM models. In addition to processed volume, density, and speeds, travel times for the study corridor were defined along the main lanes for each direction in the VISSIM models (one in the northbound direction and one in the southbound direction, between Loop 1604 and the Bexar / Comal County line). Table 7 and Table 8 show that there is an anticipated travel time savings of 48% in the northbound direction and 63% in the southbound direction, when compared to the existing conditions for both the 2018 and 2038 models, respectively.

Table 7

2018 Travel Time Comparison

Direction	Existing		2018		Difference (sec)	% Difference
	Travel Time (sec)	Travel Time (min)	Travel Time (sec)	Travel Time (min)		
NB US 281	863	14.38	446	7.44	417	48%
SB US 281	1213	20.21	448	7.46	765	63%

Table 8

2038 Travel Time Comparison

Direction	Existing		2038		Difference (sec)	% Difference
	Travel Time (sec)	Travel Time (min)	Travel Time (sec)	Travel Time (min)		
NB US 281	863	14.38	452	7.53	411	48%
SB US 281	1213	20.21	453	7.55	759	63%

Conclusions

Based on the information provided above, we draw the following conclusions:

- Opening Year:
  - All managed lanes, general purpose lanes, ramps, frontage road lanes, and intersections will operate satisfactorily with a LOS "C" or better.

- Design Year
  - Most of the managed lanes, general purpose lanes, ramps, frontage road lanes, and intersections will operate satisfactorily with a LOS “C” or better.
  - There was one segment that operated at LOS “D” with the preferred alternative constructed. This section is southbound between the Encino Rio entrance ramp and the Loop 1604 DCs exit ramp.
  - There were two ramps that operated at LOS “D”. These ramps were the southbound entrance ramp from Stone Oak and the northbound exit ramp to Stone Oak Parkway.
  - The Stone Oak Parkway / TPC intersections with both the southbound and northbound frontage roads operated unsatisfactorily, LOS “D/F”.
  - Even though most approaches at the intersections operate at LOS “D” or better, there were three approaches with a LOS “E” or “F”. These approaches are the westbound approach at the northbound frontage road with TPC, the eastbound approach at the southbound frontage road with Stone Oak Parkway, and the westbound approach at the northbound frontage road with Marshall Road.
- The opening and design years should operate satisfactorily with the TPP-developed traffic projections, with the exception of the Stone Oak Parkway / TPC intersections with the US 281 frontage roads.
- To accommodate the anticipated traffic at Stone Oak Parkway / TPC, these frontage road intersections would need to be widened/expanded in the future to relieve the anticipated congestion at this location. We recommend that this interchange be monitored for possible future expansion.
- Bexar County is planning on expanding Marshall Road between US 281 and Bulverde Road in the next few years. We recommend that Bexar County consider expanding Marshall Road to a 6-lane divided roadway to help alleviate the anticipated congestion at the Stone Oak Parkway / TPC / US 281 interchange.

15 APPENDIX E – ROADWAY DESIGN CRITERIA

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US 281 Schematic from LP 1604 to Comal County Line

Roadway Design criteria

Project Number: WJXJ4204B
January 20, 2014

ROADWAY DESIGN CRITERIA FOR US 281 SCHEMATIC

Geometric Element	US 281					US 281/LP 1604	Cross Streets	References
	Mainlanes	Entrance/Exit Ramps	HOT Lane	Managed Lanes	Frontage Rd	Direct Connectors		
Design Speed	65 mph	45 mph	45 mph	65 mph	45 mph	35 mph	30 mph	RDM Tables 3-1, 3-17, 3-20, AASHTO HOV Table 3-1
Horizontal Alignment								
Control Location	Roadway Centerline	Outside lane edge	Inside Lane	Inside Lane	Outside lane edge			
Design Stopping Sight Distance	645'	360'	360'	645'	360'	250'	200'	RDM Table 2-1, AASHTO HOV Table 3-1
Absolute Min. Radius	1660'	643	643', 50' [note 4]	1660'	643			RDM Table 2-3, AASHTO HOV Table 3-1
Max. Superelevation Rate	e(max) = 6%							AASHTO page 144, & 145
Superelevation Runoff max. relative gradient	0.43%	0.54%	0.54%	0.43%	0.54%			RDM Table 2-8
Max. Degree of Deflection w/o Horizontal Curve	0°15'0"	0°30'0"	0°30'0"	0°15'0"	0°30'0"			RDM page 2-13
Vertical Alignment								
Control Location	Inside edge of lane	Outside edge/lane	Inside edge of lane	Inside edge of lane	Outside lane edge			
Type of Terrain	Rolling terrain	Rolling terrain	Rolling terrain	Rolling terrain	Rolling terrain	Rolling terrain	Rolling terrain	
Maximum Grade	4.00%	6.00%	6.00%	4.00%	7.00%	6.00%		RDM Table 2-11, AASHTO HOV Table 3-1
Minimum Grade	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%		RDM page 2-34
K value (min) - Crest**	193	61	29	193	61	29	19	RDM Figure 2-5
K value (min) - Sag**	157	79	49	157	79	49	37	RDM Figure 2-6
Max. Algebraic Grade Break w/o Vertical Curve	0.50%	1.00%	1.00%	0.50%	1.00%	1.00%	1.00%	RDM page 2-41
Vertical Clearance								
Under/Overpass Roadway	16.5'							RDM Table 3-1
Sign Bridges	19' to bottom of sign							
Cross Sectional Elements								
Lane Widths								
Thru Lanes	12'	14'	n/a	12'	12'	12'	12'	RDM Table 3-1, and 3-18
Auxiliary Lanes	12'	n/a	n/a	n/a	n/a	12'	n/a	RDM Table 3-1
Single Lane	n/a	14'	12'	12'	n/a	14'	12'	RDM Table 3-1, AASHTO HOV Tables 3-1, 3-15
Two Lane		n/a	n/a	12'	12'	12'	12'	
Outside Lane		n/a	n/a	n/a	14'	n/a	14'	
Turning Lanes	n/a	n/a	n/a	n/a	12'	n/a	12'	
Buffer Width								
	n/a	n/a	n/a	8'	n/a	n/a	n/a	MLM Fig. 10-2
Usable Shoulder Widths	2 lanes (3+ lanes)							
Inside	4', 10' [note 3]	2', 4' [note 1]	4', (2' min.)	10', (6' min.)	4'	4'	-	RDM Table 3-18, AASHTO HOV Fig 3-3, MLM Fig. 10-2
Outside	10'	8'	10' (enf.), 8' (des.)	10', (6' min.)	Curbed	8'	-	RDM Table 3-18, AASHTO HOV Fig 3-3, MLM Fig. 10-3
Cross Slope (Lane & Shoulder)	2.0%	varies	2.0%	2.0%	2.0% (entire width)	varies	2.0%	RDM page 2-42, HOV Table 3-1
Max Grade Break	0.5% [note 2]	n/a	0.5% [note 2]	0.5% [note 2]	0.5% [note 2]	n/a	n/a	RDM page 2-31
Monolithic Curbs								
Inside	None	None	None	None	None			
Outside	None	None	None	None	Non-mountable			
* Curb Offset to Near Lane								
Inside	n/a	n/a	n/a	n/a	n/a	n/a		RDM Table 3-1
Outside	n/a	n/a	n/a	n/a	2'	n/a		RDM Table 3-1
Side Slope Rates								
Front Slope	6:1 max. in clear zone, 4:1 max. outside clear zone							RDM page 2-44
Back Slope	4:1 max.							RDM page 2-44
Clear Zone Width	30'	16'			10' inside, 6' on curbed			RDM Table 2-11
Border Width	N/A	N/A	N/A	N/A	20'			RDM Table 3-1
Sidewalk Width	N/A	N/A	N/A	N/A	6'			RDM Table 3-1

* = Based on asphalt section
** = minimum vertical curve length of 3V required
MLM TxDOT Managed Lanes Manual - (Oct 2005)
RDM TxDOT Roadway Design Manual - (Rev. October 2013)
AASHTO HOV American Association of State Highway and Transportation Officials: Guide for High-Occupancy Vehicle (HOV) Facilities - (November 2004)
AASHTO "Green Book" American Association of State Highway and Transportation Officials: Geometric Design of Highways and Streets - (2011)
AASHTO RDG American Association of State Highway and Transportation Officials: Roadside Design Guide - (2011)

Notes:
Note 1 - 2' Rdwy, 4' Str.
Note 2 - 5 lane section: 2% inside 2 lanes, 2.5% outside 3 lanes
4 lane section: 2% inside 2 lanes, 2.5% outside 2 lane
3 lane section: 2% inside 2 lanes, 2.5% outside lane
Note 3 - 4' for 4-lane divided, 10' for 6-lane divided
Note 4 - at intersections
Note 5 - Sight distance requirements may require additional width. If sight distance restrictions are predent due to horizontal curvature, the shoulder width on th einside of the curve may be increased to 8ft and the outside shoulder width decreased to 4ft.

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16 APPENDIX F – BRIDGE, RETAINING WALL, & HIGHWAY STRUCTURES DESIGN CRITERIA

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4. Design Guidelines
   Bridge Components

1. Project Overview

a. Description

The project consists of a total of twenty five (25) bridges including four (4) direct connectors, sixteen (16) main lane overpasses, three (3) braided ramp bridges, one (1) VIA overpass along main lanes, and one (1) VIA bridge to the Park-n-Ride garage. Many of the bridges are expected to be conventional prestressed concrete bridges composed of cast-in-place slabs, TxDOT Prestressed Concrete TX I-Girders, single and multi-column bents with drilled shaft foundations. The bridges for this project will also include the northern four (4) connectors for the US 281 North – Loop 1604 Interchange. Structure types for the connectors are expected to included curved steel plate girder spans, concrete and steel straddle bents, conventional and post-tensioned bents, along with spread footing, multi-shaft foundations.

b. Proposed Structure Locations

1 SE Direct Connector
2 SW Direct Connector
3 EN Direct Connector

4 WN Direct Connector
5 US 281 N ML OP @ Redland Rd
6 US 281 N ML OP @ Encino Rio
7 US 281 N ML OP @ Evans Rd
8 US 281 N ML OP @ Stone Oak NB
9 US 281 N ML OP @ Stone Oak SB
10 US 281 N ML OP @ Marshall Rd
11 US 281 N ML OP @ Wilderness Oak/Overlook Parkway
12 US 281 N ML OP @ Bulverde Rd
13 US 281 N ML UP @ Borgfeld Rd
14 US 281 N Braided Ramp (Redland Road Exit)
15 US 281 N Braided Ramp (Stone Oak Parkway Exit)
16 US 281 N Braided Ramp (Marshall Road Exit)
17 VIA Overpass to Park-n-Ride Garage
18 VIA Overpass along Mainlanes

c. Miscellaneous Structures; Minor coordination as required with the following:
   i. Culverts and headwalls (Use TxDOT Standard Design unless different conditions)
   ii. Overhead sign structures
      1. Bridge Mounted Signs
      2. Dynamic Message Signs (If applicable)
      3. Cantilever Overhead Signs
      4. Overhead Sign Bridge

   iii. Retaining & Noise Walls
      Assume the following wall types:
      1. Mechanically Stabilized Earth (MSE)
      2. Soil-Nail
      3. Rock Nail
      4. Cantilever
      5. Tie-Back

2. Design Criteria

a. Geometric Design Criteria

Consideration of substrate elements must be considered.
Minimum horizontal clearances shall conform to Table 2-12 of TxDOT Roadway Design Manual (Revised December, 2013). The manual can be downloaded from **http://onlinemanuals.txdot.gov/txdotmanuals/pse/index.htm**

Gore Areas – Columns may be placed in gore areas, but will require special protection from impact and must be coordinated with civil.

Minimum vertical clearance of 16'-6" shall be provided in compliance with TxDOT requirements for all options.

Minimum free board = 2'-0"

Structure grade and / or cross slope will be in compliance with the requirements specified in the TxDOT Roadway Design Manual referenced above.

b. Design Speeds and Traffic Volumes
   i. Design Speeds
      1. US281Main lanes = 65 mph
      2. US 281 Frontage Roads = 45 mph
      3. Direct Connectors = 35 mph
      4. Entrance & Exit Ramps = 45 mph
      5. VIA HOT Lanes = 30 mph

   ii. Traffic Volumes – (See Appendix).

c. Design Loads:

   i. Dead Loads

Unit weight of structural concrete:	150	lb/cf
Unit weight of structural steel:	490	lb/cf
Future Wearing Surface:	30	psf
Construction Loading......	20	lb/sf
Barrier, Traffic Railing (Varies):	536	plf (Max)
Temporary Railing	TBD	
Metal Deck Form	12.5	psf

   ii. Live Loads

   Use HL-93 design live load as described in Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications.

   iii. Miscellaneous
      - Drainage – Refer to the US 281 Drainage Report
      - Lighting
         - Underpass lighting
         - High mast lighting
      - Signage – as shown on sign schematic

d. Aesthetic Guidelines and Requirements
The Hill Country Theme defined within the TxDOT San Antonio District Urban Design Themes shall be used.

3. Design Standards and Guides

a. TxDOT Documents (ftp://ftp.dot.state.tx.us/pub/txdot-info/gsd/manuals, UNO)
   i. TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (http://www.dot.state.tx.us/business/specifications.htm)
      1. TxDOT Special Specifications (same website as standard Specification)
      2. San Antonio District does not have structural related Special Provisions on the website
   ii. TxDOT Bridge Design Manual – LRFD (March 2013)
   iii. TxDOT Bridge Detailing Manual (August 2001)
   iv. TxDOT Geotechnical Manual (December 2012)
   v. TxDOT Bridge Project Development (December 2012)
   vi. TxDOT PS&E (Plans, Specifications and Estimates) Preparation Manual (August 2013)
   vii. TxDOT Bridge Railing Manual (May 2013)
   viii. Preferred Practices for Steel Bridge Design, Fabrication, and Erection 2009

b. AASHTO
   i. AASHTO LRFD Bridge Design Specifications / Customary U.S. Units 2012 and 2013 Interim Revisions

c. FHWA

d. Other:
   i. TxDOT Bridge Division website
   ii. TxDOT Structural Software (http://www.dot.state.tx.us/services/information_systems/engineering_software.htm)
      1. BGS – Bridge Geometry System
      2. CAP18 – Bent Cap Analysis Program
      3. PSTRS14 – TxDOT Prestressed Concrete Design / Analysis Program
      4. WINCORE
   iii. Other allowable software
      1. STAAD / RISE / SAAP
      2. DESCUS II / MDX– Curved Box Girder Bridge System
      3. SPColumn or RC Pier
      4. LPILE or COM624
      5. MERLIN-DASH – Straight Steel & Reinforced Concrete Girder Bridge System

4. Design Guidelines:

Bridge Components

The preliminary schematic design of the structural elements of this project shall be in compliance with the TxDOT LRFD Bridge Design Manual (as referenced above). The document can be downloaded from ftp://ftp.dot.state.tx.us/pub/txdot-info/gsd/manuals/lrf.pdf.

Structures shall conform with the following Design Specifications and Standards as applicable. In case of conflicting requirements between the various design documents, TxDOT Design Manual shall control:

1. AASHTO LRFD Bridge Design Specifications (as referenced above)

2. AASHTO / AWS Bridge Welding Code 1.5, latest edition.

17 APPENDIX G –ILLUMINATION DESIGN CRITERIA

US 281

Illumination Design Criteria

JACOBS

Texas Department of Transportation

Jan-14

Description		Design Criteria: Mainlanes & DCs		Design Criteria: Entrance/Exit Ramps
Roadway Classification		Urban Freeway	Urban Freeway	
Continuous/Safety Lighting				
Luminaires		TxDOT approved fixtures		
		400 W HPS, 480V with IESNA Type AR3 distribution, 250 w HPS, 480 V w/IESNA AR2 distribution		250 w HPS, 480 V w/IESNA AR2 distribution
Poles	Type	50'/40' Poles, 10'/8' Arms		40' Poles, 8' Arms
	Base	Breakaway Transformer bases		
Luminance		Min 0.2 foot candles		
		Uniformity Ratio 3:1		
		Average Illumination 0.6 - 0.9		
		Light Loss factor 0.65		
Circuit		Single Circuit		
Power		480 volts single phase		
Voltage Drop		Max 6%		
Conduit		Min 2"		
Wire size		max #2 AWG, min #8 AWG		
Ground Boxes	Type	TxDOT Type D (no traffic loading)		
	Spacing	460' max		
Connections		Terminal board for conductor to luminaire connection, and 2" Horizontal Slip Fitter attachment		
Photo cell		Fixture closest to electrical service requires photocell		
Underpass Lighting				
Luminaires		150W HPS, 480V w/IESNA Type AR3 distribution		
		For structure > 25' above roadway, use 250W luminaire		
		2" diameter arm, 2 feet long (typical)		
		TxDOT approved fixtures		
Circuit		On regular Illumination Circuit via ground box		
		Mount 30A fused switch on bridge		
Conduit		1" from disconnect to luminaires		
Wire size		#12 AWG from disconnect to luminaires		
		max #2 AWG, min #8 AWG from electrical service to disconnect		

Notes: HIM - TxDOT Highway Illumination Manual

1 Illumination design on US281 will follow TxDOT HIM, TxDOT Standard Specs
2 Illumination design SH 121 will follow NTTA's RESM, TxDOT Illumination Manual and Standard Specs (when NTTA does not have guidance)
3 US 281 intersections/frontage roads - Illumination is Safety
4 US 281 main lanes - Illumination is Continuous.
5 Continuous Layout at 1" = 100', Details at 1"=40', Underpass Lighting layout at 1" = 40'

US 281 EIS

CONCEPTUAL SCHEMATIC (10%) TECHNICAL MEMO

CSJ: 0253-04-138

August 2011

Prepared For

ALAMO RMA
Alamo Regional Mobility Authority
"Moving people faster"

Stephanie Messerli

STATE OF TEXAS
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Appendices: Available upon request.

Appendix A: Design Criteria Table
Appendix B: Horizontal Alignment Reports
Appendix C: Drainage Calculations
Appendix D: Cost Estimate Detail

Introduction

The US 281 EIS is being prepared for the Alamo Regional Mobility Authority (Alamo RMA) to evaluate improvements to the US 281 roadway from Loop 1604 to Borgfeld Drive. The project limits fall completely within Bexar County.

Existing US 281 is composed of three typical roadway sections within these project limits. A short section on the southern end of the project between Loop 1604 and Sonterra Boulevard is a six-lane freeway section. From Sonterra Boulevard to Stone Oak Parkway, US 281 is primarily a six-lane divided arterial. From Stone Oak Parkway to Borgfeld Drive, US 281 is a four-lane divided arterial with periodic left and right turn lanes.

This memo details the design criteria and other factors evaluated during the 10 percent conceptual plan development to evaluate two potential improvement alternatives. The two alternatives are described as follows.

Expressway Alternative (non-tolled, tolled, or managed lanes)
The Expressway Alternative is a limited access facility with continuous one-way frontage roads along US 281. It consists of three main lanes and two/three frontage road lanes in each direction.

Elevated Expressway Alternative (non-tolled, tolled, or managed lanes)
The Elevated Expressway Alternative is an elevated, limited access roadway with two/three main lanes and two/three frontage road lanes in each direction; existing US 281 lanes would remain in place and function as frontage roads. Along the southern section of the roadway, from Loop 1604 north to Stone Oak Parkway, the elevated main lanes would be built on the outside of the existing US 281 roadway and would transition to the west side of the existing US 281 roadway on the northern section north of Stone Oak Parkway to Borgfeld Drive.

Design Criteria

The *TxDOT Roadway Design Manual* was the primary resource for design criteria and guidance. This resource was supplemented with *AASHTO's Policy of Geometric Design of Highways and Streets* when necessary. The geometric design criteria selected for this project is provided in Appendix A. The horizontal alignment reports for each alternative are provided in Appendix B.

Drainage/Water Quality

The project area is divided into 23 basins to facilitate the drainage and water quality analysis for the two alternatives. These basin areas were determined using the existing creek and culvert crossings along with the proposed vertical profiles for each of the alternatives. Crossings flow from west to east with a few exceptions. For both of the alternatives, the US 281 existing culverts would be extended upstream and downstream depending on the limits of the proposed improvements. No additional culverts are proposed for this phase of the analysis. The total extended lengths are provided in *Appendix D*. The Expressway Alternative requires the replacement of the existing bridges at Mud Creek with four longer bridges. For the Elevated Expressway Alternative, the existing bridges at Mud Creek will remain in place.

Detention and water quality ponds were sized for both of the alternatives. The City of San Antonio requires that proposed storm water runoff not increase from the original conditions. The detention pond sizes for the 100-year storm were determined using the Modified Rational Method. Each basin could have more than one detention pond depending on the culvert location within the basin and the space available for the ponds. The project is located in the Edwards Aquifer recharge zone, thus the Texas Commission on Environmental Quality (TCEQ) requires the reduction of total suspended solids (TSS) load. The water quality ponds were sized for all the alternatives using TCEQ's TSS removal spreadsheet. Each basin will have at least one water quality pond to meet the requirements. The detention and water quality pond locations are shown on the Conceptual Schematic Layouts, and summaries of the calculations are provided in *Appendix C.*

The project includes the floodplains of Mud Creek, two unnamed tributaries to Mud Creek, West Elm Creek, Elm Waterhole Creek, and Cibolo Creek. Mud Creek and the two unnamed tributaries are designated as "Zone A" on the FEMA floodplain map: Bexar County, Texas Flood Insurance Rate Map 48029C0277F dated January 4, 2002. The proposed improvements directly affect Mud Creek both upstream and downstream of US 281. West Elm Creek and Elm Waterhole Creek are both designated as "Zone A" downstream of US 281. The proposed improvements for all the alternatives could impact the 100-year floodplains. West Elm Creek is shown on FIRM 48029C140F dated January 4, 2002, and Elm Waterhole Creek is shown on FIRM 48029C0130F also dated January 4, 2002. Cibolo Creek is designated as a "Zone AE" on FIRM 48029C130F. The existing bridges for Cibolo Creek are remaining in place and no new structures are being proposed at this creek, but the proposed water quality and detention ponds are in the proximity of the creek's 100-year floodplain.

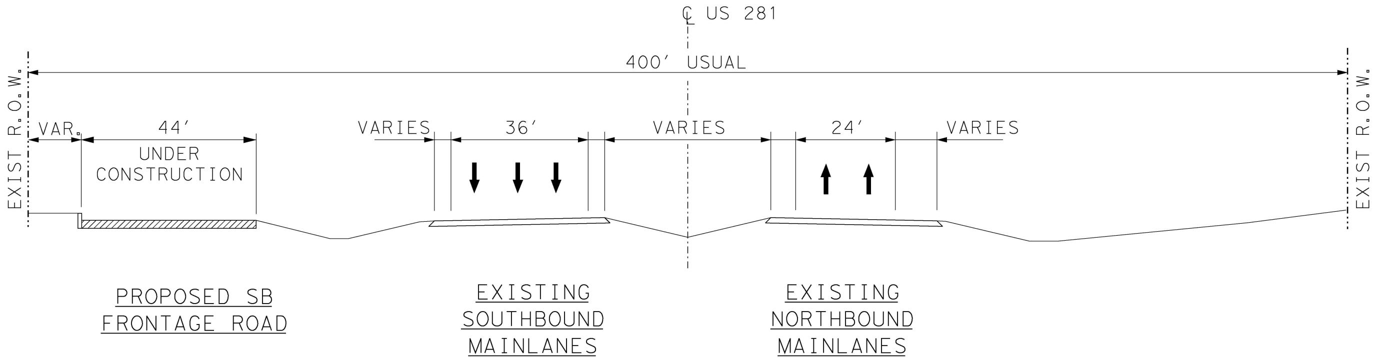
Construction Phasing

Each alternative was evaluated to determine a general phasing of construction. These phasing descriptions are only intended to provide an overview of how traffic would be handled during the construction activities and are developed under the assumption that the entire corridor would be constructed under one construction project. Later phases of design will determine more specific phasing details.

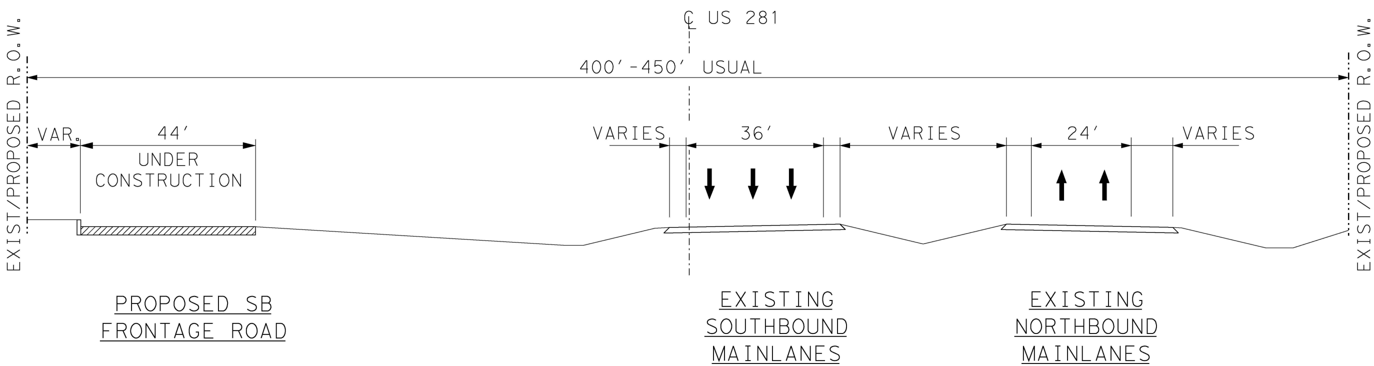
EXPRESSWAY ALTERNATIVE – The Expressway Alternative can be constructed by the use of the following three phases of traffic handling.

Phase 1

1. Traffic remains on existing US 281 mainlanes.
2. Construct the proposed southbound frontage roads (SBFR) throughout the length of the project along with any SB ramps that do not interfere with existing US 281 traffic.



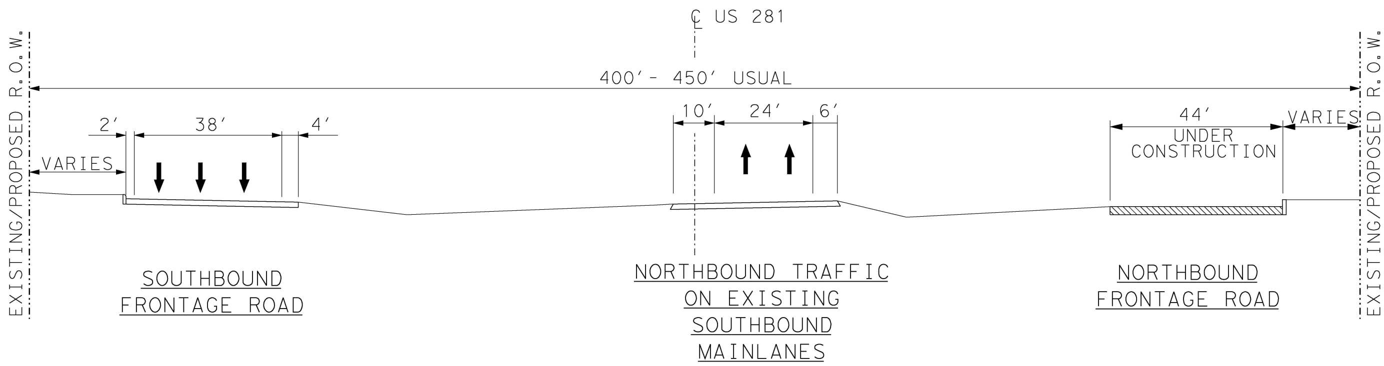
EXPRESSWAY ALTERNATIVE PHASE 1
SOUTH OF STONE OAK PKWY



EXPRESSWAY ALTERNATIVE PHASE 1
NORTH OF STONE OAK PKWY

Phase 2

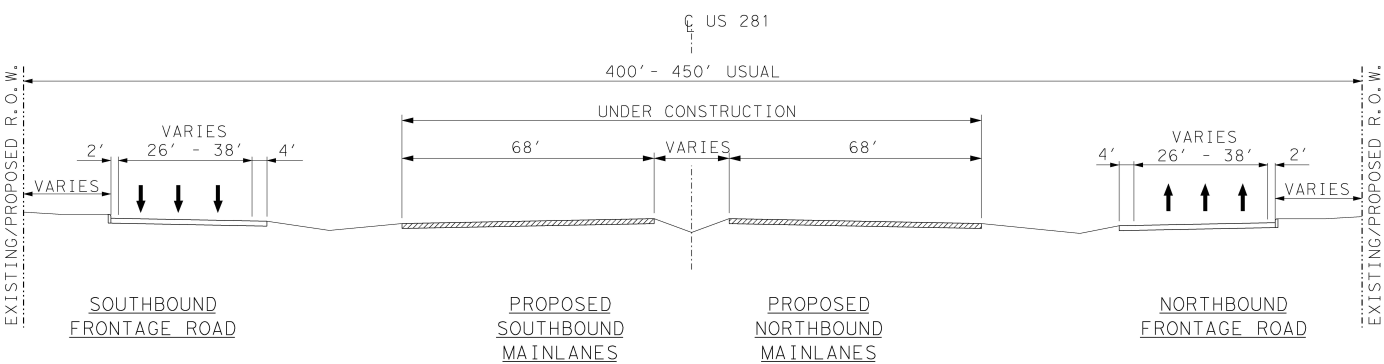
1. Upon completion of the proposed SBFR, place SB traffic onto the SBFR.
2. Place NB traffic onto the existing SB mainlanes (SBML).
3. Construct the proposed NB frontage road (NBFR) and any NB ramps that do not interfere with US 281 traffic.



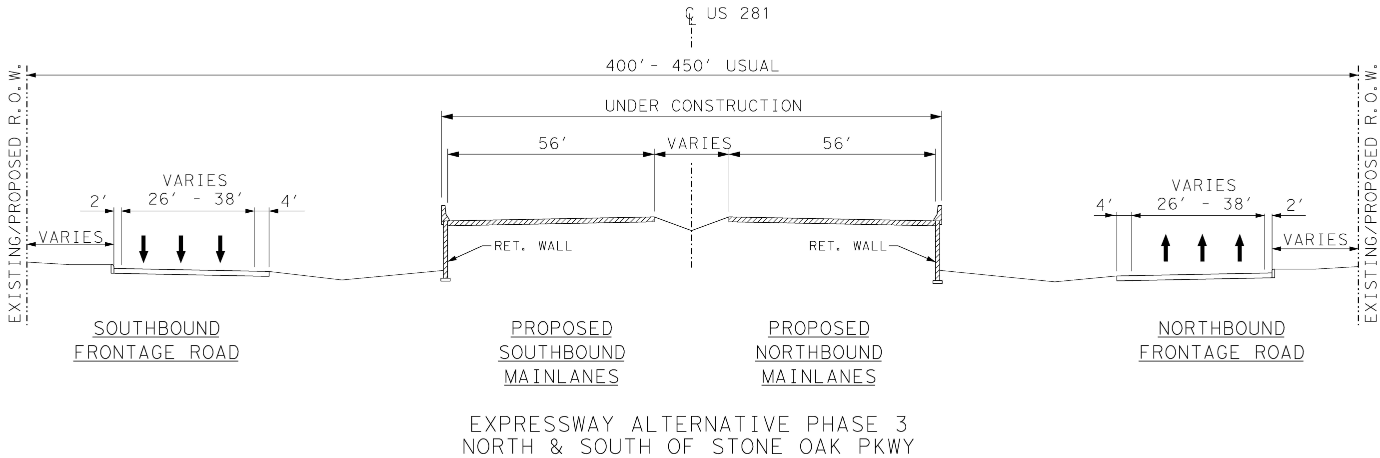
EXPRESSWAY ALTERNATIVE PHASE 2
NORTH & SOUTH OF STONE OAK PKWY

Phase 3

1. Upon completion of the proposed NBFR, place the NB traffic onto the NBFR.
2. With traffic on the frontage roads, construct the proposed NBML & SBML. Intersections are to be constructed under traffic and may require lane closures and night work.

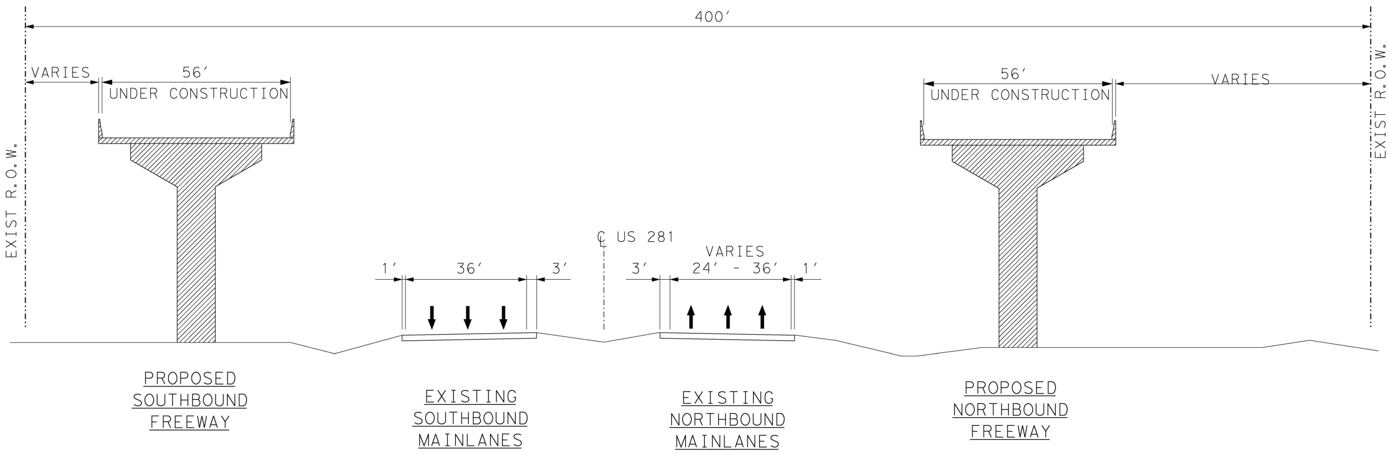


EXPRESSWAY ALTERNATIVE PHASE 3
NORTH & SOUTH OF STONE OAK PKWY

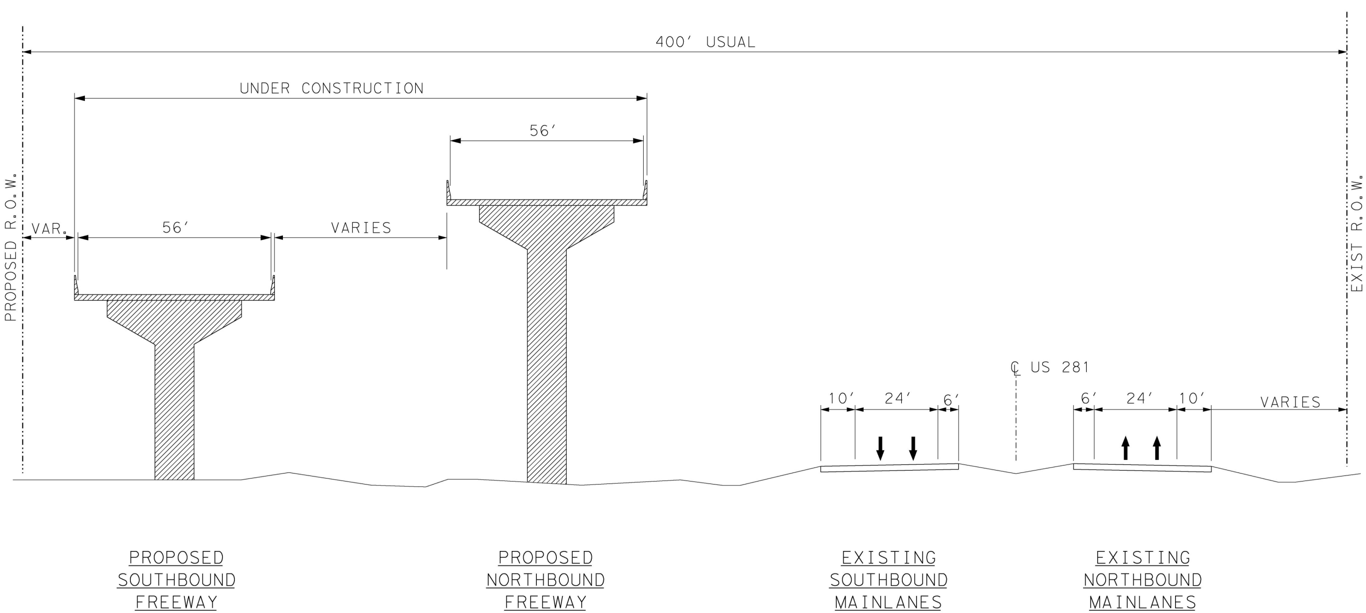


ELEVATED EXPRESSWAY ALTERNATIVE – The majority of the Elevated Expressway Alternative construction occurs outside of the existing US 281 pavement and will follow the general steps provided below.

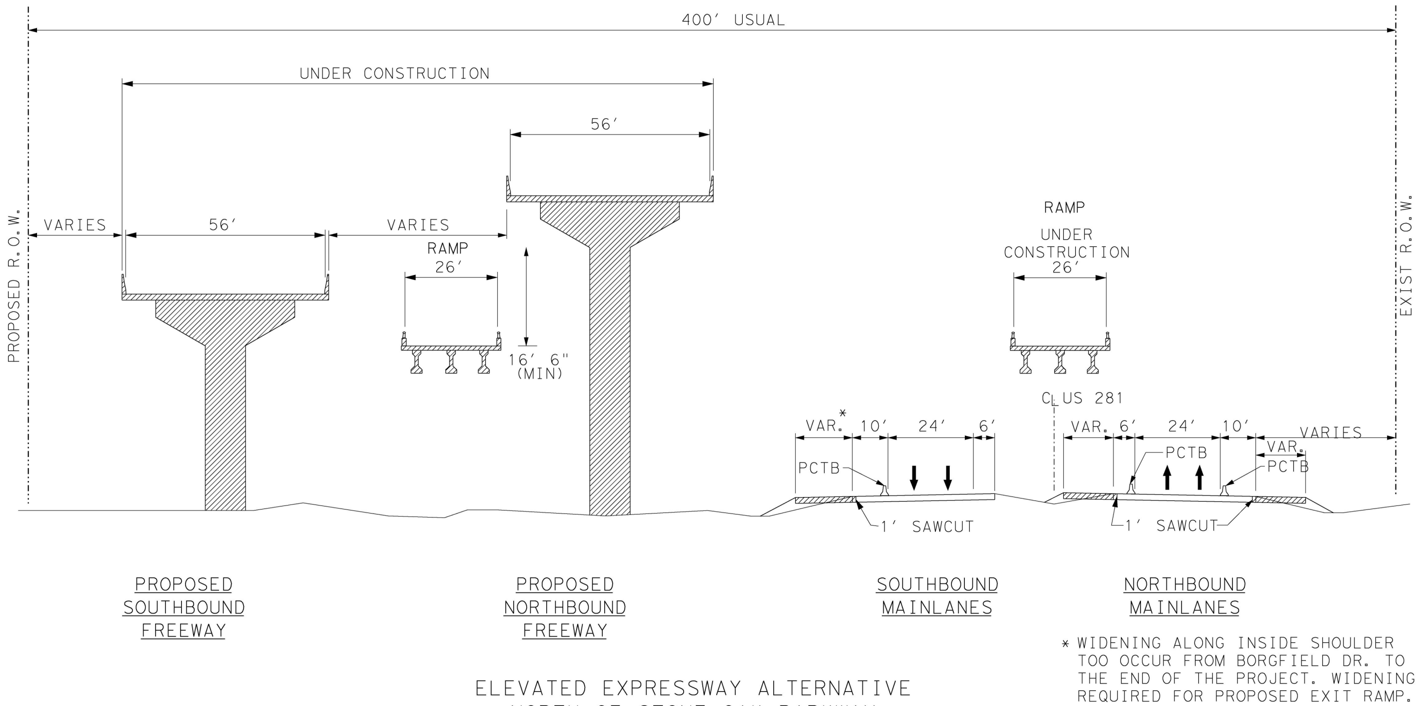
1. Traffic remains on existing US 281 mainlanes.
2. Construct the proposed US 281 mainlanes, access roads, bridge structures and ramps.
3. Place PCTB along outside shoulder of existing US 281 mainlanes and widen the exisiting pavement to accommodate the proposed entrance and exit ramps which merge into the proposed mainlanes.
4. Place PCTB along the inside shoulder of the exisiting US 281 NB mainlanes from Borgfeld Dr. to the end of project. Closure of the inside shoulder is necessary to allow for the pavement widening required to accommodate the proposed NB exit ramp.
5. Night work and lane closures will be required to complete all proposed construction (bent construction, beam placement, deck pours, etc) which crosses over or encroaches upon the existing US 281 mainlanes.



ELEVATED EXPRESSWAY ALTERNATIVE
SOUTH OF STONE OAK PARKWAY



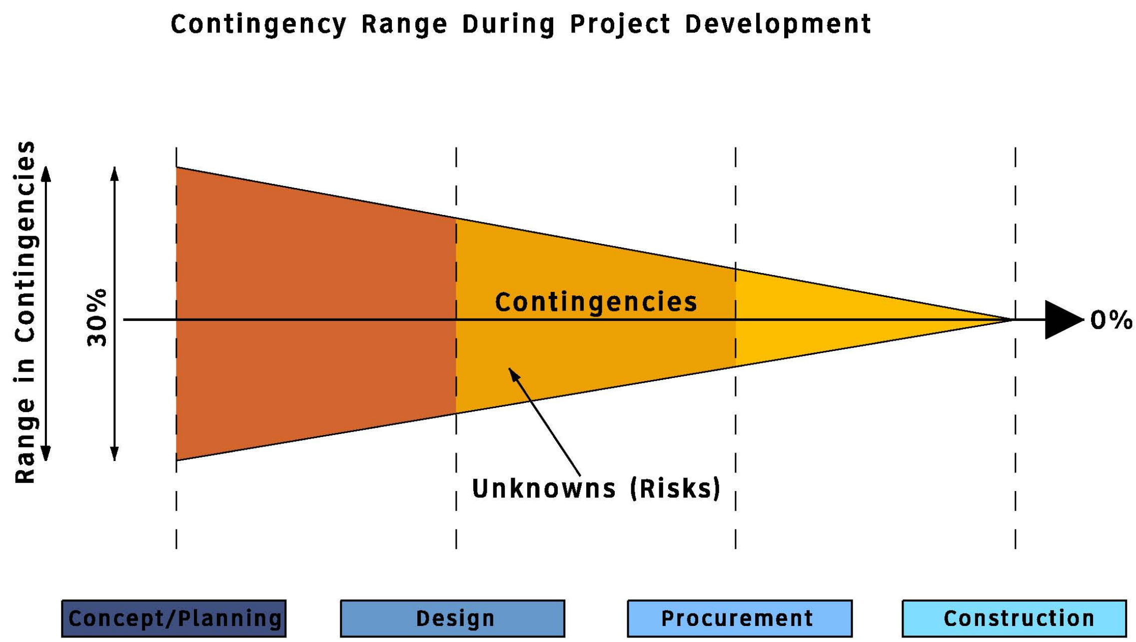
ELEVATED EXPRESSWAY ALTERNATIVE
NORTH OF STONE OAK PARKWAY



ELEVATED EXPRESSWAY ALTERNATIVE
NORTH OF STONE OAK PARKWAY

Cost Estimates

See pages 10-12 for a summary of cost items for each alternative. Due to the early design stage of this project, a 30 percent contingency factor was applied to the construction estimate. It is typical at this stage of design to apply a contingency factor to account for project costs that have not yet been identified. As the design is more clearly defined, the contingency factor will decrease and eventually become zero percent as the project moves into construction. The following figure illustrates the typical evolution of contingencies for a project.



For a detailed summary of the quantity and unit costs developed, see Appendix D. Costs were based on 2010-2011 bid history data. The right of way costs were estimated based on a percentage of the land that would need to be acquired and whether the existing improvement(s) would need to be purchased. The parcel values came from the Bexar County 2010 appraisal district.

The cost for each alternative is as follows:

Alternative	Total Engineering, Construction & ROW Cost	Tolling/Managed Lanes Cost	Total Cost with Tolling/Managed Lanes
Expressway	$433,985,133	$14,000,000**	$447,985,133
Elevated Expressway	$646,184,035	$9,000,000**	$655,184,035

**These costs include a five percent mobilization fee as well as equipment costs and installation. Within the professional services, there are allowances for design, testing, project management, and software license fees. The equipment costs include gantries, video cameras, lighting, UPS and backup generator, equipment housing, toll related signage, MOMS, communication systems, AVC system, a pavement tolling apron (including markings, lane controls etc) and the foundations and geotechnical design of the gantries. The Expressway Alternative cost is based on four assumed tolling locations and the Elevated Expressway Alternative cost is based on three assumed tolling locations.

EXPRESSWAY ALTERNATIVE				
ITEM	**UNIT**	**UNIT COST**	**UNIT AMOUNT**	**COST**
Prep ROW Costs	STA	$ 2,300	385	**$ 885,500**
Earthwork				
Unclassified Excavation	CY	$ 5	1,197,008	$5,985,040
Unclassified Embankment	CY	$ 3	2,297,302	$ 6,891,906
Earthwork Sub-total:				**$ 12,876,946**
Pavement				
Mainlane (2 Ln)	LF	$ 355	2,773	$ 983,750
Mainlane (3 Ln)	LF	$ 448	51,694	$ 23,149,044
Mainlane (4 Ln)	LF	$ 541	18,228	$ 9,858,758
Mainlane (5 Ln)	LF	$ 634	1,359	$ 861,479
Frontage Road (2 Ln)	LF	$ 272	41,541	$ 11,294,647
Frontage Road (3 Ln)	LF	$ 365	26,049	$ 9,506,331
Frontage Road (4 Ln)	LF	$ 458	4,350	$ 1,992,253
Frontage Road (5 Ln)	LF	$ 551	3,251	$ 1,791,424
Turnaround (20' Width)	LF	$ 220	6,365	$ 1,400,549
Ramp (1 Ln)	LF	$ 184	33,158	$ 6,106,778
Ramp (2 Ln)	LF	$ 308	1,609	$ 495,952
Driveways	LSUM	$ 637,484	1	$ 637,484
Crossing Roadway				
Redland (between FRs)	LF	$ 282	486	$ 137,087
Redland (outside of FRs)	LF	$ 344	118	$ 40,604
Encino (between FRs)	LF	$ 502	294	$ 147,621
Encino (outside of FRs)	LF	$ 642	272	$ 174,538
Evans	LF	$ 688	710	$ 488,628
Stone Oak	LF	$ 502	670	$ 336,414
Marshall (between FRs)	LF	$ 437	328	$ 143,386
Marshall (outside of FRs)	LF	$ 344	500	$ 172,052
Wilderness	LF	$ 468	507	$ 237,362
Overlook	LF	$ 502	707	$ 354,992
Bulverde (between FRs)	LF	$ 468	319	$ 149,346
Bulverde (outside of FRs)	LF	$ 324	819	$ 265,146
Borgfeld (between FRs)	LF	$ 533	305	$ 162,604
Borgfeld (outside of FRs)	LF	$ 324	921	$ 298,168
Pavement Sub-total:				**$ 71,186,395**
Retaining Walls				
Retaining Wall (MSE)	SF	$ 35	595,593	$ 20,845,755
Retaining Wall (Tieback)	SF	$ 80	128,425	$ 10,274,000
Retaining Wall Sub-total:				**$ 31,119,755**
Bridges				
Overpass	SF	$ 50	521,228	$ 26,061,400
Direct Connector	SF	$ 70	382,806	$ 26,796,420
Bridge Sub-total:				**$ 52,857,820**
Traffic Signals	EA	$ 150,000	9	**$ 1,350,000**
Traffic Control (Barricades)	MO	$ 25,000	36	**$ 900,000**
Project Sub-total:				**$ 171,176,416**
Drainage Structures	LSUM	$ 29,034,912	1	**$ 29,034,912**
Signing, Striping, Delineation (2%)	LSUM	$ 3,423,528	1	**$ 3,423,528**
Illumination (10%)	LSUM	$ 17,117,642	1	**$ 17,117,642**
Pedestrian & Context Sensitive Solutions (10%)	LSUM	$ 17,117,642	1	**$ 17,117,642**
SW3P (2%)	LSUM	$ 3,423,528	1	**$ 3,423,528**
TCP (3%)	LSUM	$ 5,135,292	1	**$ 5,135,292**
Utilities (10%)	LSUM	$ 17,117,642	1	**$ 17,117,642**
SUB-TOTAL:				**$ 263,546,602**
30% Contingency				$ 79,063,981
10% Mobilization				$ 34,261,058
TOTAL:				$ 376,871,641
7% Engineering:				$ 26,381,015
RIGHT OF WAY:				$ 30,732,477
GRAND TOTAL:				**$ 433,985,133**

ELEVATED EXPRESSWAY ALTERNATIVE				
ITEM	**UNIT**	**UNIT COST**	**UNIT AMOUNT**	**COST**
Prep ROW Costs	STA	$ 2,300	385	**$ 885,500**
Earthwork				
Unclassified Excavation	CY	$ 5	194,374	$ 971,870
Unclassified Embankment	CY	$ 3	91,264	$ 273,792
Earthwork Sub-total:				**$ 1,245,662**
Pavement				
Ramp (1 Ln)	LF	$ 204	11,767	$ 2,399,653
Ramp (2 Ln)	LF	$ 277	2,179	$ 604,086
Mainlane (2 Ln)	LF	$ 339	1,008	$ 341,966
Mainlane (3 Ln)	LF	$ 510	505	$ 257,470
Mainlane (Widening)	LF	$ 123	16,483	$ 2,029,085
Access Road (Residential)	LF	$ 98	2,032	$ 199,194
Access Road (Residential with C&G)	LF	$ 137	2,426	$ 331,337
Access Road (Commercial)	LF	$ 145	12,142	$ 1,765,847
Pavement Sub-total:				**$ 7,928,639**
Retaining Walls				
Retaining Wall (MSE)	SF	$ 35	143,731	$ 5,030,582
Retaining Wall (Tieback)	SF	$ 80	1,750	$ 140,000
Retaining Wall Sub-total:				**$ 5,170,582**
Bridges				
Mainlane	SF	$ 65	3,759,472	$ 244,365,680
Ramp	SF	$ 65	402,558	$ 26,166,270
Direct Connector	SF	$ 70	137,844	$ 9,649,080
Bridge Sub-total:				**$ 280,181,030**
Traffic Signals	EA	$ 150,000	4	**$ 600,000**
Traffic Control (Barricades)	MO	$ 15,000	48	**$ 720,000**
Project Sub-total:				**$ 296,731,413**
Drainage Structures	LSUM	$ 21,207,999	1	**$ 21,207,999**
Signing, Striping, Delineation (1%)	LSUM	$ 2,967,314	1	**$ 2,967,314**
Illumination (10%)	LSUM	$ 29,673,141	1	**$ 29,673,141**
Pedestrian & Context Sensitive Solutions (10%)	LSUM	$ 29,673,141	1	**$ 29,673,141**
SW3P (1%)	LSUM	$ 2,967,314	1	**$ 2,967,314**
TCP	LSUM	$ 3,500,000	1	**$ 3,500,000**
Utilities	LSUM	$ 20,000,000	1	**$ 20,000,000**
SUB-TOTAL:				**$ 406,720,322**
30% Contingency				$ 122,016,097
10% Mobilization				$ 52,873,642
TOAL:				$ 581,610,061
7% Engineering:				$ 40,712,704
RIGHT OF WAY COST:				$ 23,861,270
GRAND TOTAL:				**$ 646,184,035**

Elevated Expressway Alternative Storm Sewer Summary

ALTERNATIVE	400 2003	402 2001	432 2066	464 2003	464 2005	464 2007	464 2009	464 2010	464 2011	464 2022	464 2024	464 2026	464 2027
	STRUCT EXCAV (PIPE)	TRENCH EXCAVATION PROTECTION	RIP RAP (CONC) (CL B)	RC PIPE (CL III) (18 IN)	RC PIPE (CL III) (24 IN)	RC PIPE (CL III) (30 IN)	RC PIPE (CL III) (36 IN)	RC PIPE (CL III) (42 IN)	RC PIPE (CL III) (48 IN)	RC PIPE (CL IV) (24 IN)	RC PIPE (CL IV) (30 IN)	RC PIPE (CL IV) (36 IN)	RC PIPE (CL IV) (42 IN)
	CY	LF	CY	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
ELEVATED EXPRESSWAY	23270	19217	1523	25758	10422	6902	1962	4080	1022	1564	1040	295	612
Unit Price	$3.00	$2.00	$275.00	$30.00	$40.00	$50.00	$65.00	$85.00	$100.00	$50.00	$70.00	$115.00	$140.00
TOTAL COST	$69,808.50	$38,434.50	$418,893.75	$772,726.50	$416,898.00	$345,123.93	$127,500.75	$346,774.50	$102,150.00	$78,187.50	$72,765.00	$33,896.25	$85,680.00

The Elevated Expressway Alternative is estimated to be 45% of the cost of the Expressway Alternative.

ALTERNATIVE	464 2028	465 2001	465 2007	465 2006	465 2014	465 2081	465 2092	465 2188	465 2203	465 2211	465 2253
	RC PIPE (CL IV)(48 IN)	INLET (COMPL)(TY C)	INLET EXT (TY C)	MANH (COMPL) (JUNCT BOX) (TY M)	MANH (COMPL) (JUNCT BOX)	INLET (COMPL)(GRATE) (TY 1)	MANH (COMPL)(TY 1)	INLET (COMPL)(DROP) (TY Y-1)	INLET (COMPL)(CTB) (TY S)	JUNCTION BOX (SPL)	INLET (COMPL)(CTB) (TY M)
	LF	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA
ELEVATED EXPRESSWAY	153	8	8	57	5	9	32	85	8	20	65
Unit Price	$140.00	$3,500.00	$1,500.00	$4,100.00	$4,000.00	$3,000.00	$3,200.00	$4,600.00	$7,000.00	$9,000.00	$6,000.00
TOTAL COST	$21,420.00	$28,350.00	$12,150.00	$232,470.00	$18,000.00	$27,000.00	$103,680.00	$389,160.00	$56,700.00	$182,250.00	$388,800.00

The Elevated Expressway Alternative is estimated to be 45% of the cost of the Expressway Alternative.

Elevated Expressway Alternative Cross Culvert Summary

ELEVATED EXPRESSWAY ALT CROSS CULVERTS

	0462 2002 CONC BOX CULV (3 FT X 3 FT) LF	0462 2004 CONC BOX CULV (4 FT X 3 FT) LF	0462 2010 CONC BOX CULV (6 FT X 3 FT) LF	0464 2024 RC PIPE (CL IV) (30 IN) LF	466 2020 WINGWALL (FW-0) (HW=4 FT) EA	466 2034 WINGWALL (FW-S) (HW=4 FT) EA	468 2067 HEADWALL (CH-FW-0) (DIA= 30 IN) EA
A							
B							
C							
D							
E	25				1		
F	30					1	
G							
H							
I			135			1	
J							
K							
L							
M							
N	262				1	1	
O							
P							
Q							
R	32					1	
S							
T		66			1	1	
U							
V							
W				49			1
TOTAL	349	66	135	49	3	5	1

Unit Price	$100	$120	$180	$70	$4,050	$8,000	$3,500

TOTAL COST	$34,900	$7,920	$24,300	$3,430	$12,150	$40,000	$3,500

Elevated Expressway Alternative Detention and Water Quality Pond Summary

ELEVATED EXPRESSWAY ALT PONDS		
	DETENTION POND CF	WATER QUALITY POND CF
AA	12,333	6,356
A	21,082	6,215
B	20,698	151,793
C	14,884	4,096
D	40,194	20,804
E	16,681	11,184
F	34,098	15,998
G	69,225	29,020
H	37,142	14,967
I	121,236	69,165
J	29,946	17,973
K	12,550	3,405
L	16,795	6,465
M	72,720	37,822
N	42,825	19,533
O	31,978	10,204
OO	178,150	81,314
P	34,587	14,157
Q	73,860	35,829
R	30,176	10,189
S	23,776	3,646
T	14,845	3,164
U	56,985	27,734
V	20,891	5,652
W	29,257	7,700
TOTAL	1,056,913	614,385

Unit Price	$10	$10

TOTAL COST	$10,569,134	$6,143,845